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CANADIAN PUBLIC HEALTH JOURNAL

DEVOTED TO PREVENTIVE MEDICINE

VOLUME 32 March, 1941 NUMBER 3

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THIRTIETH ANNUAL MEETING, QUEBEC, JUNE 9-11

PUBLISHED MONTHLY BY THE
CANADIAN PUBLIC HEALTH ASSOCIATION
111 AVENUE ROAD TORONTO

To be published on April 25th

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CANADIAN
PUBLIC HEALTH JOURNAL

VOL. 32, NO. 3 MARCH, 1941

Rheumatic Heart Disease—A Public Health Problem*

JOHN D. KEITH, M.D.†

IN the past forty years a tremendous amount of research has been expended on rheumatic infection. Ever since the discovery of a diplococcus by Poynton and Payne in 1900 it has been thought that a little more bacteriological investigation would make rheumatic fever yield its secret and the cause would be clearly identified. During this period long strides were made in diphtheria and other bacterial diseases and in the early days it was hoped that similar results might be achieved in rheumatic fever. In 1922, Dr. Carey Coombs, one of the most prominent students of the disease at that time, strongly supported the belief that the diplococcus of Poynton and Paine was the etiological agent. Three or four years later, Dr. Homer Swift of the Rockefeller Institute put forward the theory of allergy to the streptococcus. This suggestion was the most prominent in the field for nearly ten years but recently has been less strenuously supported.

In the past decade numerous other origins of the disease have been advanced: vitamin C deficiency by Rhinehart, virus by Amies and Eagles, vitamin B deficiency by Vining, pleuro-pneumonia-like organism by Swift. Now at the beginning of the fifth decade since the turn of the century the exact cause is still unknown and in spite of several thousand experiments and papers we are only a little further ahead from the etiological point of view than forty years ago.

Those interested in rheumatic fever have put forth their greatest effort in seeking a precise cause, hoping no doubt for a spectacular advance which would lead to a specific theory. Since this has not been achieved it is possible that

*Read at the meeting of the Academy of Medicine, Toronto, Section of Preventive Medicine and Hygiene, January 30, 1941.

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the tortoise of public health may win the race after all. Its less spectacular methods may reach the goal before the etiological agent is discovered. It is the opinion of the writer that present-day knowledge adequately applied could largely eliminate the disease without our knowing any more about the cause than we do now.

There are three main headings under which I would like to discuss the public health problem of rheumatic fever and rheumatic heart disease:

1. The first is incidence.
2. The second is a broad interpretation of the cause.
3. The third is treatment; this is based mainly on the ideas elaborated in the cause.

INCIDENCE

Because of the splendid system of health supervision in schools, developed on this continent and in England, certain statistics are available on heart disease among school children. The references are summarized in table I. We see that there is approximately the same incidence of rheumatic heart disease in England as in the northern half of the U.S.A. The figures for Canada are in the same general range. All these figures are far from accurate but they provide a rough guide in estimating the prevalence in children.

Interpreting these percentages as total numbers, we have over 200,000 children with rheumatic heart disease attending public school in the U.S.A. and between 20,000 and 30,000 in Canada.

TABLE I

ESTIMATED INCIDENCE OF RHEUMATIC HEART DISEASE IN SCHOOL CHILDREN*
Summary of References in Literature

Source	Number of References	Approximate Average Incidence of Rheumatic Heart Disease
Great Britain	15 references	.10-2.08% of school population
U.S.A.	13 references	.29-1.36% " "
Canada	18 cities	.36-3.92% " "

Reliable statistics on adults are even more difficult to obtain. Possibly the best estimate available on the whole population is that made by J. R. Paul, who gathered data from schools, conscription records of the last war, and from insurance companies. He concluded that there were 840,000 cases of rheumatic heart disease per 100 million people in the U.S.A. This would give a figure of 1,100,000 cases in the present population of 130 million.

Another useful group of statistics on incidence are provided by deaths from rheumatic heart disease. Some of the best and most interesting are those gathered by Hedley in Philadelphia in 1936. Rheumatic heart disease was fourth in order as a cause of death in the infectious-disease group, including all ages. Tuberculosis, lobar pneumonia, and syphilis preceded it. In the under-20 age-group, however, rheumatic heart disease was second only to tuberculosis and its mortality was greater than the total from whooping cough,

*Rheumatic heart disease incidence taken as 80 per cent of number of cardiac defects recorded.

measles, meningococcus meningitis, diphtheria, scarlet fever, and anterior poliomyelitis.

Besides the study in Philadelphia, Hedley recently published data gathered for the whole of the U.S.A. The deaths from heart disease in the age-group 5-24 years are due mainly to rheumatic fever and he found that in 1936 there were 6,321 cardiac deaths recorded in this age-group. Further, since only one-fifth of the deaths from rheumatic heart disease occur in this age-group, we can conclude that there are at least 31,000 deaths in the United States each year from this cause. Insurance company statistics would place this figure much higher, so in this estimation we have probably erred on the side of moderation.

It will be obvious that all the figures available on frequency of the disease are based on a most insecure footing. Each figure must be apologized for in some degree and although we are able to form a general idea of the incidence we cannot be happy about conclusions drawn from them.

To correct this situation, we need three things to start with:

1. Compulsory reporting of the disease.
2. A plan for accurate incidence statistics in schools.
3. Accurate etiological diagnoses on death certificates.

With these three points in force we could determine how many new cases are developing each year and how many are dying. Only then could we tell whether our methods of control and prevention are doing the job. We would have a target to aim at, a number to reduce, and I believe that if we could see clearly our objectives, great strides could be made in eliminating rheumatic fever as a cause of crippling and death.

CAUSE

A specific cause for rheumatic fever has been the Golden Fleece for hundreds of investigators and many hopes have been wrecked in the search. Yet the accumulated data point quite definitely to certain things. Just as in most diseases there are certain conditions which lead to the onset, so I believe there are three fundamental causes of rheumatic fever.

The first is temperature change. Rheumatic fever is more common in northern climates than down south. The only investigator who did the examining himself in both north and south is J. R. Paul of New Haven. This study was done on Indian school children in western U.S.A. In the north 4.5 per cent had rheumatic heart disease, in the middle 1.9 per cent, and in the south, at the Mexican border, 0.5 per cent. The difference in temperature is considerable whereas the rainfall and moisture are much the same in these areas.

Rheumatic fever is a disease of the colder months of the year, as is shown in a study by Kaiser at Rochester, N.Y. He found that there was a steady increase in rheumatic attacks during the fall, reaching its maximum in February, March, April and May, and falling rapidly again in the summer.

In summary, it is a disease of the north rather than the south. It is a

disease of the winter rather than the summer. It is a disease of poorly heated houses and it is a disease of poorly clad children.

The second cause is associated with the economic status. This relationship is generally accepted, but I will refer you to one study that demonstrates it clearly. In a study of New Haven school children by Paul and his associates, he found the following incidence of rheumatic heart disease: poor district city schools, 4.8 per cent; better district city schools, 3.1 per cent; private schools, 0.6 per cent.

To analyse this factor further, I believe that there are three conditions in the lower economic group that are conducive to rheumatic infection: (1) heating and clothing, (2) overcrowding, and (3) diet.

The first we have referred to. The second condition was studied by Perry of Bristol. He compared the incidence of rheumatic fever in the homes of Bristol with the number of people occupying them. There was a direct relationship between the occurrence of rheumatic fever and the number of people in a dwelling, and he concluded that the greater the degree of overcrowding, the more likely we are to find the disease. The association of overcrowding with disease has led to a steady increase over the years in the space of cubic feet allotted to a man in the army. His living quarters in this war are required to be more spacious than ever before and groups are reduced to smaller numbers.

The third condition is that of diet. Many people believe now that the greatest difference between the well-to-do and less well-to-do as far as health is concerned is in diet. Five dollars a week spent on an individual's food usually results in an adequate diet. Two dollars or less a week results almost invariably in a diet inadequate in some essentials. Warner, Sadow, Rhinehart, Paul, all found deficiencies in the diets of large groups of rheumatics. In addition, Paul found that among the northern Indians, where rheumatci fever was common, nearly half of the children were underweight, whereas down south, where rheumatic fever was rare, only 8 per cent were underweight and 45 per cent were overweight.

The third factor in causation is the haemolytic streptococcus. We may summarize our recent knowledge on this point in a few brief statements. Twenty-five per cent of children suffering from acute rheumatic fever have positive throat cultures for haemolytic streptococcus. A similar incidence is found in control groups, so that no definite conclusions can be drawn from these obervations. Approximately two-thirds of acute rheumatic attacks are preceded by an obvious cold or sore throat. Practically all of these rheumatics have notably increased antibodies to the haemolytic streptococcus in the blood stream during the active disease process. The antibody test used is the anti-streptolysin which is accepted by most bacteriologists as reliable evidence of a recent acute haemolytic streptococcus infection.

The seriousness of a sore throat in this disease is realized when it is remembered that a patient with known rheumatic heart disease who develops a haemolytic streptococcal infection of the throat stands an even chance of getting a recurrence of his rheumatic fever.

To recapitulate, I believe the disease process is associated with three fundamental causes:

(1) Temperature changes

(2) Economic status { Heating and clothing / Overcrowding / Diet }

(3) Haemolytic streptococcus.

TREATMENT

The solution of the rheumatic problem ultimately depends on the treatment available, both prophylactic and active.

This has been faced most realistically in London and by the time the war broke out a highly efficient method of dealing with rheumatic fever in children

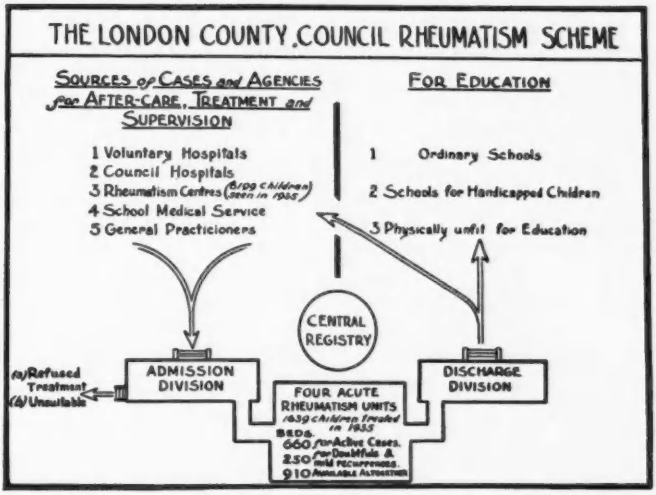

FIGURE 1

had been developed. This is summarized briefly in figure 1. Before studying this diagram one should have in mind the objectives of the London County Council scheme:

1. The provision of accommodation in special hospitals outside London of beds sufficient in number to provide for an average period of treatment of six months for all children showing signs of active rheumatic disease.

2. The establishment of rheumatism supervision centres for the purpose of early diagnosis of doubtful cases and supervision of quiescent cases.

3. The establishment of a system of supervision of cases after discharge from rheumatic hospitals.

4. Investigation and amelioration, if necessary and possible, of the child's home environment.

5. The central coordination of various branches of the scheme.

The patients come from five main sources. An admission board decides who may be admitted. A number have to be turned away as unsuitable. There are four hospitals with 910 beds in all, 660 for active cases and 250 for possible or questionably active patients. When the period of treatment is over and recovery is established they are referred to various supervisory centres by the discharge board. Educational facilities are provided for those who are incapacitated.

The most important factor in the treatment is rest. A point that illustrates the value of rest very forcibly is the fact that rheumatic valvular disease is a disease of the mitral and aortic valves and rarely are the pulmonary and tricuspid involved. This appears to be mainly because the blood pressure is higher on the left side of the heart than the right. Thus there is more mechanical strain put on the mitral and tricuspid valves with each heart beat. Some have gone so far as to suggest that if the systemic blood pressure was normally as low as the pulmonary, rheumatic fever would cease to be a disease of outstanding importance.

Another factor in the English scheme that deserves special mention is the care of the doubtful or possible cases of rheumatic infection. These are usually children six, seven, or eight years of age who, if uncared for, might develop frank rheumatic carditis. Discovered early, the disease-producing conditions may be corrected and any permanent crippling prevented. In tuberculosis the skin test, examination of the sputum, and X-ray make the diagnosis of mild cases much easier. In rheumatic fever we have no skin test to rely on and we tend to lean away from making the diagnosis of mild or possible cases and wait until frank signs have appeared, which means that some cases are neglected.

For the reasons mentioned before, I believe diet is an important factor in treatment and prevention of the disease. The child should have at least three glasses of milk a day; fruit daily, particularly oranges, tomatoes or grapefruit, since they are the only really good source of vitamin C throughout the year; green vegetables; eggs or meat daily. Cod liver oil and vitamin B complex are prescribed as additions since many diets are somewhat deficient in these. We also recommend whole wheat bread and whole wheat cereal.

INFECTION

The first consideration is to see that no focus of infection exists. The two foci most frequently involved are teeth and tonsils. If an alveolar abscess is present, and we frequently find them, we always have the offending tooth extracted. In regard to tonsils the data available are not entirely unanimous but certain facts are clear. Rheumatic fever frequently starts with a throat infection and sore throats are reduced by the removal of tonsils. This has recently been demonstrated by Kaiser, who showed that children whose tonsils had been removed had one-third as many sore throats when they reached 12-17 years as those whose tonsils had not been removed.

Unfortunately, however, recurrences of rheumatic symptoms are not pre-

vented by tonsillectomy, but it seems likely that the disease process is made less malignant. Kaiser found that patients without tonsils had a lower mortality rate than those with their tonsils intact.

For these reasons and because certain patients are markedly benefited by the operation, the majority of physicians recommend tonsillectomy in a large proportion of rheumatic patients. We advise the operation in most instances.

Because infections so often precede rheumatic attacks, it is important that any known rheumatic patient developing a cold or a sore throat should remain in bed until all signs of disease have subsided and should be examined by a physician before returning to school. In treating the colds we find that these children tolerate sulphathiazole well and we recommend its use in colds and

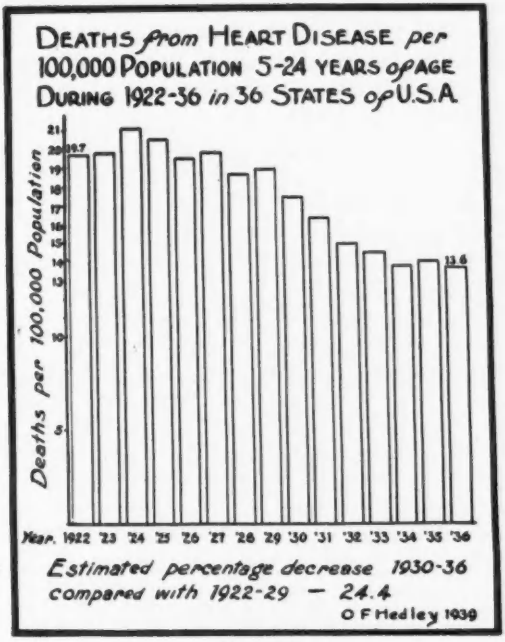

FIGURE 2

sore throats to prevent a recurrence of rheumatic fever. It is too early to say from our studies but we believe that recurrences are thus being reduced or minimized. Once the rheumatic symptoms have developed we have not found the drug of any value as yet. It seems possible that the widespread use of chemotherapy may diminish the incidence and severity of streptococcal infections and so contribute to the reduction of rheumatic diseases. Evidence is accumulating that sulphanilamide given in a daily dose over two or three years will considerably reduce the possibility of a recurrence in a known rheumatic.

Finally an effort to improve the environment from which these children

come will help to get at the root of the problem. More space per person is needed, with less overcrowding. Very likely when the war is over and reconstruction begins in England these factors will be paramount in housing schemes, especially if the present Minister of Works and Housing remains in office.

THE FUTURE

You will say that many or all of these factors have been in operation for some time and conditions are steadily improving, therefore we should see a resultant reduction in rheumatic fever. This appears to be true; Atwater, Cohn, Dublin, all have found a slow but definite decrease in rheumatic infection from the beginning of the century. The most reliable evidence has appeared recently in the United States Public Health Reports. This is the statistical investigation referred to before, by Hedley (figure 2).

Hedley gathered data from the thirty-six states having registration for the past twenty-nine years. The figures in the table are based on deaths from heart disease in the age-groups 5 to 24 years. These are mainly rheumatic (approximately 85 per cent) and are therefore suitable to show the trend of the disease.

In 1922 there were 19.7 deaths from cardiac disease per 100,000 population in that age group. In 1936 this figure had fallen to 13.6. This is quite encouraging and it shows that progress is being made in spite of the fact that the exact cause is not known and no specific therapy is in use.

It is evident that certain factors are at work which are lowering the mortality quite appreciably. It is our business to pick out these factors and utilize them to the fullest extent so that the curve will drop rapidly to negligible numbers.

Administration of Toxoid and Results of Schick Testing in Glace Bay, Nova Scotia, 1938-1939*

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DIPHTHERIA has been a matter of concern for some years in Cape Breton County. A review of statistics for the ten-year period 1929 to 1938 shows a total of seventy-seven deaths from this disease in a population of 92,000. During the years 1930 to 1938, a total of 485 cases was reported. That this reporting was not complete is indicated by the fact that in twenty-six instances deaths were recorded in communities from which no cases were reported.

The use of diphtheria toxoid in this county is not a new procedure. It had been used in North Sydney and Dominion No. 6 as early as 1929 and 1930. For the past few years the medical health officer for Cape Breton South has as a routine practice visited county schools yearly and administered toxoid. The medical officer for the town of New Waterford states that during the past few years three thousand children received toxoid. Unfortunately there are no records as to who received toxoid, nor, what is more important, who received three doses, for, as is generally known, immunity can be expected only with three doses of the plain toxoid.

Following the increase in the nursing staff after the formation of the Cape Breton Island Health Unit in 1937, it became possible to provide additional nursing service for the local medical officers in their immunization program and to organize the various communities so that immunization against diphtheria would become a yearly procedure. School and preschool toxoid clinics are now held in rural Cape Breton County, north and south; Sydney, New Waterford, Dominion, North Sydney, Sydney Mines, Louisburg, and Glace Bay. During 1938 in these communities a total of 10,994 children started the series of toxoid inoculations and 9,669 (88 per cent) completed three inoculations.

On considering these figures it seemed desirable to ascertain where this program was leading us and what results might be expected from the procedure. As all the urban communities had much the same diphtheria experience, it was felt that a detailed study of one community would serve as a sample to indicate what might be expected. The town of Glace Bay was chosen and complete co-operation from officials, doctors and parents obtained.

Glace Bay has a population of 20,706 (1931). It is a mining town with

**An address given at the annual meeting of the Nova Scotia Health Officers' Association in Digby, N.S., in June 1939 and published in the Nova Scotia Medical Bulletin. In view of the interest in this study, the author has added further observations. The article appears in this issue with the consent of the Bulletin.*

medical practice chiefly financed through the "check-off" system. The reported diphtheria incidence for the ten years 1929 to 1938 was fifty-six cases with twelve deaths. This represents a case fatality rate of twenty-one, which is more than twice that usually experienced with diphtheria. It may therefore be inferred that reporting of cases of the disease was incomplete.

The toxoid campaign was begun in January 1938. The campaign was first discussed with the Board of Health, the School Board, and the physicians. All physicians were willing and anxious to give their services. Space for publicity was generously donated by the local newspaper. The publicity consisted of pertinent articles, comments by local physicians, and editorials.

The schools were the administration centres for the conduct of the immunization program. Permission slips supplied by the Department of Health were left with the school principals, who instructed the teachers to distribute them among the classes. No school child was given toxoid unless the permission slip was signed. No age limit was placed for receiving toxoid. Clinics for preschool children were arranged at suitable places, usually at a school. Permission slips were not used for this group but parents were requested to accompany the children. A schedule was drawn up. The doctors who had indicated their willingness to attend were notified as to the time and place their services were required. If a doctor was unable to attend, he accepted the responsibility of supplying a substitute.

A clinic was arranged in each school, with two physicians and five nurses in attendance. Each physician had two syringes for his use. One nurse attended to the refilling of these syringes and the sterilization of needles. Other nurses attended to the sterilization of the area of inoculation of the children's arms. This system worked well, as there was no case of infection in the series. One nurse was responsible solely for the records.

The individual record card had the child's name on it and the permission slip was attached. The children from each classroom were lined up and, as they approached the physician, the card was left with the record nurse, who entered the date of the inoculation. At the conclusion of the clinic a summary of the work was made and the cards returned to the teacher so that they would be available for further reference. When the series of injections had been completed, the cards were filed in a central place.

The Department of Public Health supplied the toxoid and the records and, in conjunction with the local medical officer of health, developed the system employed. The town of Glace Bay supplied the syringes, alcohol and needles. Sterile goods were supplied by the local hospitals, who also sent undergraduate nurses to assist. Plain diphtheria toxoid as prepared by the Connaught Laboratories was used. This requires three inoculations of one-half cc., one-half cc., and one cc. at intervals of three weeks.

RESULTS OF THE CAMPAIGN

The school enrollment in Glace Bay in 1938 was 5,324. Of this group 82.6 per cent started the series of inoculations and 77.8 per cent completed it. This indicates that there was a falling off of about 5 per cent. Actually, 94.3

per cent of school children starting received three doses. With this "school series" has been combined the "preschool series" so that in the tables the division of "school" and "preschool" disappears and is replaced by age-group divisions. This has been done to avoid purely artificial distinction.

Tables I and II present data concerning those who received toxoid, arranged according to sex and age-group.

TABLE I

NUMBER RECEIVING PLAIN TOXOID ACCORDING TO SEX AND NUMBER OF DOSES RECEIVED, GLACE BAY, 1938

Sex	Doses of Toxoid						Total	
	1 Dose		2 Doses		3 Doses			
	No.	%	No.	%	No.	%	No.	%
Male	136	4.4	124	4.3	2602	91.3	2862	100
Female	124	4.6	146	5.1	2667	90.3	2937	100
Total	260	4.4	270	4.6	5269	91.0	5799	100

Table I shows very little difference in the number of each sex receiving toxoid and practically the same percentage of each receiving one, two or three doses.

TABLE II

NUMBER RECEIVING PLAIN TOXOID ACCORDING TO AGE GROUP AND NUMBER OF DOSES, GLACE BAY, 1938

Age Group	Doses of Toxoid						Totals	
	1 Dose		2 Doses		3 Doses			
	No.	%	No.	%	No.	%	No.	%
0- 4 yrs.	115	11.2	84	8.2	825	80.5	1024	17.6
5- 9 "	82	3.5	102	4.4	2109	92.1	2293	39.5
10-14 "	50	2.3	74	3.4	2013	94.3	2137	36.3
15-19 "	13	3.7	10	3.4	322	92.9	345	6.6
Total	260	4.4	270	4.6	5269	91.0	5799	100.0

Table II presents the number receiving one, two or three doses of plain toxoid according to age-groups. The following points are worthy of mention:

1. Only 80.5 per cent of the 0 to 4 age-group were brought for three doses, whereas among the "school age" groups the range was from 92 to 94 per cent. This cannot be explained on the basis of toxoid reactions, for no "combined" Schick reactions were observed before the child had received three doses. It may be that there was misunderstanding as to the number of doses required for immunity, or perhaps some parents may have felt timid about the use of the needle. On the other hand, the school children had little choice and what

TABLE III

SCHICK TESTS GIVEN AND READ
ACCORDING TO AGE GROUP AND TOXOID RECEIVED
GLACE BAY, 1939

Age Group	No Toxoid			1 Dose Toxoid					2 Doses Toxoid					3 Doses Toxoid				
	No. Schick Tested	Schick Tests Read		No. Rec. Tox.	Schick Tested		Schick Tests Read		No. Rec. Tox.	Schick Tested		Schick Tests Read		No. Rec. Tox.	Schick Tested		Schick Tests Read	
		No.	%		No.	%	No.	%		No.	%	No.	%		No.	%	No.	%
0- 4 yrs....	34	34	100	115	17	14.7	17	100	84	12	14.6	12	100	825	363	44.0	352	98.3
5- 9 "	298	272	91.3	82	62	75.5	58	93.5	102	80	66.2	76	95.0	2109	1891	89.6	1836	97.1
10-14 "	157	145	92.4	50	41	82.0	38	92.7	74	67	90.5	66	98.5	2013	1796	89.2	1749	97.4
15-19 "	310	233	75.1	13	3	23.8	3	100	10	5	50	5	100	322	209	64.8	201	96.1
Total.....	799	684	85.6	260	123	47.4	116	94.1	270	164	60.8	159	97.0	5269	4259	80.6	4138	97.1

SUMMARY OF SCHICK TESTS GIVEN AND READ

Age Group	No. Rec. 1 or more Doses Toxoid	Schick Tested		Schick Tests Read		No. Toxoid and Schick Test	Schick Tests Read		Total Schick Tests	Total Schick Tests Read	
		No.	%	No.	%		No.	%		No.	%
0- 4 yrs	1024	302	38.2	381	97.3	34	34	100	426	415	97.4
5- 9 "	2293	2033	88.6	1970	97.3	298	272	91.3	2331	2242	96.2
10-14 "	2137	1904	88.6	1853	97.3	157	145	92.4	2061	1998	96.9
5-19 "	345	217	62.9	209	96.3	310	233	75.1	527	442	83.9
Total...	5799	4546	78.4	4413	97.1	799	684	85.6	5345	5097	95.4

misgivings they may have had about the repeated dosage were largely offset by the School Board's putting up a cup to be awarded to the school with the greatest percentage of its enrollment completing the series.

2. The absence of age limits for those receiving toxoid is also to be noted. Some authorities are diffident about giving toxoid to children over the age of eight without a preliminary Schick test; others go as high as twelve years. Those in Glace Bay who wished to have toxoid received it, regardless of age, and the percentage receiving one, two or three doses runs remarkably close when broken into age-groups, although, as we will see later, combined reactions were most evident over the age of ten. Unfortunately it was not possible to keep an accurate record of reactions from toxoid but inquiry from the physicians indicated that there were very few. Certainly no serious reactions were experienced under twelve years of age. Several febrile reactions associated with localized swelling were observed in the older age-groups.

3. Of all those receiving toxoid, 17.6 per cent belonged to the 0 to 4 age-group, 39.5 per cent to the 5 to 9, 36.3 per cent to the 10 to 14, and 6.6 per cent to the 15 to 19. Finally, of all those receiving the first dose, 91 per cent received the third dose.

THE SCHICK TEST AND ITS SIGNIFICANCE

The Schick test is used to determine the immunity status in reference to diphtheria. It consists of two parts, the test with the toxin and the test with the control. Dilute diphtheria toxin containing 1/50th M.L.D. in 0.1 cc. is injected intradermally. If there is sufficient circulating antitoxin in the patient's blood stream, the toxin is neutralized and no reaction occurs. If there is less than the necessary amount of antitoxin to protect against the disease, a reaction is noted in the skin which lasts from several days to several weeks, depending on the intensity of the reaction. The diphtheria toxin also contains diphtheria protein to which a person may be sensitive, and this can produce a reaction which without further study might be interpreted as a positive reaction. In order to differentiate this protein sensitivity from susceptibility to disease, a control test is employed. This consists of 0.1 cc. of dilute toxoid, which contains no toxin but does contain the diphtheria protein. It will therefore be seen that the following reactions to the Schick test are possible when read at an interval of seven days:

Toxin	*Control*	*Interpretation of Reading*
No Reaction	*No Reaction*	*Negative*
No Reaction	*Reaction*	*Negative*
Reaction	*No Reaction*	*Positive*
Reaction	*Reaction*	*Combined*

The status of immunity in individuals showing a combined reaction cannot be interpreted, since it is not possible to state definitely whether protein or toxin or both are causing the reaction. To classify these combined reactions, blood from the individual must be taken and the antitoxin titre determined in a laboratory equipped to make such determinations. An endeavour was

TABLE IV

ANALYSIS OF SCHICK TEST READINGS
ACCORDING TO AGE GROUPS, REACTION AND DOSES OF TOXOID GIVEN
GLACE BAY, 1939

Age Group	Negative								Positive								Combined							
	Doses of Toxoid								Doses of Toxoid								Doses of Toxoid							
	No Tox.		1 Dose		2 Doses		3 Doses		No Tox.		1 Dose		2 Doses		3 Doses		No Tox.		1 Dose		2 Doses		3 Doses	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
0- 4 yrs	2	6.0	7	41.2	10	83.3	333	94.6	32	94.0	10	58.8	2	16.6	7	1.9	0	0.0	0	0.0	0	0.0	12	3.3
5- 9 "	60	22.1	18	31.0	48	61.5	1649	89.8	202	74.3	35	60.3	23	29.5	97	5.3	10	3.6	5	8.4	5	6.4	90	4.8
10-14 "	28	19.3	10	26.3	37	50.0	1528	87.4	103	71.0	15	39.5	19	28.8	40	2.3	14	9.6	13	34.2	10	14.5	181	10.4
15-19 "	39	16.8	1	?	0	....	169	84.1	173	74.1	2	?	2	?	12	5.8	21	9.0	0	0.0	3	?	20	9.8
Totals	129	18.8	36	31.0	95	59.7	3679	88.9	510	74.5	62	53.3	46	28.8	156	3.8	45	6.4	18	15.5	18	11.3	303	7.3
	3939—77.1%								774—15.2%								384—7.7%							
5097—100%																								

made in this study to classify combined reactions as *probably negative*, *probably positive*, and *doubtful*, by comparing the intensity of the two reactions. In the tables, however, the combined reactions are classified as such without differentiation.

ADMINISTRATION OF THE SCHICK TEST

In this series both arms were used for the test, the left for the toxin and the right for the control. The skin of the anterior surface of the forearm was the site of injection. The tests were read seven days after they were made. The public health nurse in the district and I read the first thousand or more tests, after which the majority were read by the nurse. It was decided to read the tests very stringently and therefore the results may be taken as the minimum of negative and the maximum of positive and combined reactions.

Immunity following three doses of plain toxoid is usually established six weeks or two months after the last inoculation. At this time the highest level of immunity is found. In this series the tests were not given until ten to twelve months after the last inoculation of toxoid. Thus the results indicate the level of immunity one year after toxoiding was completed.

ANALYSIS OF OBSERVATIONS ON SCHICK TEST READINGS

When it was decided to perform the Schick test, we offered to administer the test not only to those completing the series of three inoculations but also to anyone in the school or preschool group who desired it whether they had received no toxoid, or one, two or three doses. This resulted in a series of 5,345 Schick tests of which 5,097, or 95.4 per cent, were read. Seven hundred and ninety-nine who had received no toxoid were given the test and of these 684 or 85.6 per cent were read. This latter group served as a significant control as well as indicating the level of immunity in the untreated children. Of those receiving one, two or three doses of toxoid, 4,546, or 78.4 per cent, were tested, and 4,413, or 97.1 per cent, were read. Of the 5,097 Schick tests done and read, 15.1 per cent had received no toxoid, 2.3 per cent had received one dose, 3.1 per cent two doses, and 79.5 per cent three doses of plain toxoid.

Tables III and IV present the results of the reading of the tests. All negative reactions are statistically significant.

Table III summarizes the Schick tests given and read according to doses of toxoid received and age-group.

A group of 799 who had received no toxoid desired to be tested. Six hundred and eighty-four (85.6 per cent) tests were read. Two hundred and sixty received but one dose of toxoid. Of these, 123 were tested and 94.1 per cent read. Two hundred and seventy received two doses of toxoid. One hundred and sixty-four of these were tested and 97 per cent read. Five thousand two hundred and sixty-nine received three doses of toxoid. Of this group, 4,259, or 80.6 per cent, were tested and 97.1 per cent read.

Table IV summarizes the result of Schick test readings according to age-group and number of doses of toxoid received. Reactions are grouped as negative, positive, or "combined."

Study of the negative reactions shows that in the age-group 0-4, only 6 per cent of those who did not receive toxoid were immune. The number in this group is extremely small, but the percentage can be accepted as reflecting the immunity status. The next age-group (5-9) shows 22 per cent immune without receiving toxoid. It is acknowledged that as age increases more will be found immune, but this is not shown clearly in our observations, probably because the groups are not large enough. The whole group receiving no toxoid showed only 18.8 per cent immunity, which emphasizes the low level of immunity in a "non-toxoided" population. One can picture what might happen if an outbreak of diphtheria occurred.

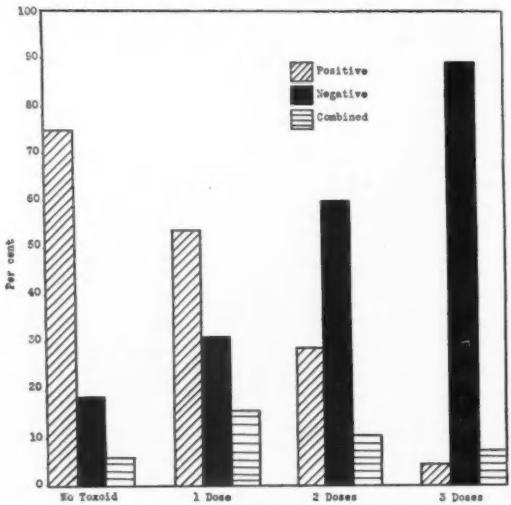

FIGURE 1

Results of Schick Tests (5097) according to Doses of Toxoid Received, Glace Bay, 1939.

The group receiving toxoid shows an immediate and increasing level of immunity as one passes from the group receiving one and two doses to those receiving three doses. I wish to point out that the 88.9 per cent negative reactions observed in the group receiving three doses of toxoid, represents the "pure" negative reactions. If, along with this group, the "combined probably negative" reactions were included, the level of immunity would be increased to 93 per cent. Because no titrations for circulating antitoxin were carried out, this group was not included in the results. From the practical standpoint they are probably immune.

The positive reactions are the inverse of the negative. Among the "no-toxoid group" the percentage showing susceptibility to diphtheria further emphasizes the low level of immunity in an "untoxoided" district and the fact that only 3.8 per cent (156) showed a clear-cut positive reaction after three

doses of toxoid, is conclusive evidence of the efficiency of toxoid in producing immunity to diphtheria.

The combined reactions, as previously mentioned, indicate reaction to the control and apparent or real reaction to the toxin. The reaction to the control itself indicates sensitivity to diphtheria protein, and therefore some degree of reaction to the inoculations of diphtheria toxoid may be expected in this group. Of the whole series of 5,097 read, 384 or 7.7 per cent, showed combined reaction. Of all the combined reactions 12, or 3.1 per cent, occurred under 5 years of age; 110, or 28.6 per cent, between 5 and 9 years of age; 204, or 53 per cent, between 10 and 14 years of age; and 84, or 15.2 per cent, over 15. These observations indicate clearly that reactions to toxoid may be expected in a fair proportion of cases over the age of ten, although these reactions are only transient in nature and rarely are severe. It will be noted further that the largest percentage of combined reactions (34.2 per cent) occurred among those who received only one dose of toxoid in the 10 to 14 age-group. It is highly probable that reaction to the first dose is the reason this group of children did not proceed to receive the second and third doses of toxoid. Another interesting point is the similarity in the percentage of combined reactions among those who received no toxoid (6.4 per cent) and those who received three doses (7.4 per cent).

FURTHER PROGRESS IN DIPHTHERIA CONTROL

The toxoiding program has been continued in all towns and rural sections of Cape Breton County. At the end of the fiscal year (November 30, 1940), 17,186 children had received three doses of plain toxoid. This is a minimum as considerable immunization is done by private physicians aside from the work of the toxoid clinics.

This toxoid program, together with a close watch for diphtheria carriers among contacts and cases, has produced the following satisfactory results:

Year	*Cases Reported*	*Deaths*
1938	127	13
1939	35	6
1940	16	0

In the year 1940, of the sixteen cases reported, five occurred in one family. None of these received toxoid. There were no deaths from diphtheria in Cape Breton County in 1940.

CONCLUSIONS

1. The administration of plain diphtheria toxoid in three doses at intervals of three weeks on the mass immunization plan is a safe procedure.

2. More attention must be given to children of preschool age to assure that they receive the three doses required for immunization.

3. Five thousand, seven hundred and ninety-nine children who received one to three doses of toxoid were offered the Schick test to ascertain their immunity status. Four thousand, five hundred and forty-six, or 78.6 per cent,

received the test. In addition, 799 children who had not received any toxoid were tested. Of 5,345 Schick tests done, 5,097, or 95.4 per cent, were read.

4. Three doses of plain diphtheria toxoid produce immunity to diphtheria as gauged by the Schick test. This is evidenced by negative reactions ranging from 18.8 per cent in those with no toxoid to 89 per cent in those with three doses, or, conversely, 74.5 per cent positive in those who did not receive toxoid to 3.8 per cent in those with three doses. Combined reactions are not included in these figures.

5. Despite an increasing immunity noted with one, two and three doses of plain toxoid, only three doses can be relied on to produce immunity.

6. While no serious reactions were encountered in the 5,799 receiving toxoid at all ages up to twenty, it is probably advisable to test children over the age of twelve for sensitivity before proceeding with the administration of toxoid. All adults must be Schick-tested before toxoid is administered, for two reasons: (*a*) to determine the presence or absence of immunity, and (*b*) to determine whether there is sensitivity to diphtheria protein. If the latter exists, and the individual is susceptible to diphtheria, a special preparation of dilute toxoid is available for immunization.

7. A community cannot be considered as secure against an outbreak of diphtheria if the child population, especially those of the preschool age-group, has not been toxoided. The administration of three doses of plain toxoid develops such a high level of immunity in the population that an epidemic of diphtheria need not be feared.

8. The tendency in any immunizing campaign is to "do the schools." Important as this is, emphasis must be placed on the necessity of immunizing the preschool group, for it is this group that bears the brunt of an epidemic of the common communicable diseases, among which diphtheria is no exception. No toxoid campaign can be considered complete unless its organization includes the preschool child.

ACKNOWLEDGMENT

I wish to express my appreciation of the assistance provided by the late Dr. A. L. MacLean of Dalhousie University in carrying out the Schick tests in this group.

A New Phage and a Susceptible W Form of S. Typhi isolated from a Typhoid Fever Case*

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THE routine use, in a public health laboratory, of Craigie's phage-typing methods for identifying V forms of *S. typhi*, and for determination of their type, has been described by Helmer, Kerr, Dolman and Ranta (1). Reference was made by these authors to the wide range of types represented among a comparatively small group of strains isolated in British Columbia. Of the 18 types and sub-types for which specific Vi phages are at present available, three new types (G, H, and M) were inaugurated by strains encountered among the first 62 cultures isolated after typing was begun in this province. Type M strains proved less susceptible to a mixture of Craigie's phages I and IV than did two strains of late lactose-fermenting coliforms isolated from faeces; and it was pointed out that such findings made it undesirable for public health laboratories to rely solely upon phage-susceptibility reactions for the identification of *S. typhi*. Since typing began three years ago in this laboratory, among 94 V form cultures isolated to date from British Columbia sources, no less than 11, or 11.7 per cent, have been type M. By contrast, Lazarus (2) who has recently summarized the results of a survey of the types of *S. typhi* sent to him over a period of ten months by various laboratories in western United States, found only one type M strain among 392 V form cultures, an incidence of 0.25 per cent. The comparative insusceptibility of type M strains to the phage I-IV mixture can be overcome by inclusion in the mixture of a Vi phage designated III by Doctor Craigie, and kindly supplied by him, to which type M strains are fully susceptible. But the fact that type incidence may show marked variations in different localities, and even in adjacent regions, as exemplified above, suggests that V forms of *S. typhi* may exist which would prove resistant to the phage I-III-IV mixture.

Helmer et al. (1) also mentioned the occasional isolation from faeces of imperfect V, or even W forms, as an additional reason why public health laboratories should not dispense with the accepted confirmatory tests for the identification of *S. typhi*. Among a total of 102 strains freshly isolated in this laboratory, 9 proved to be of the so-called "imperfect V" form. Such forms are impossible to type because of their resistance to Craigie's Vi phage II, but they are fully susceptible to phage I; and use of the latter phage in the preliminary test mixture against suspected cultures would ordinarily ensure that imperfect V forms would not be missed. However, in the event that colonies of *S. typhi* isolated by stool culture from a case or carrier were all of

*Presented at the ninth annual Christmas meeting of the Laboratory Section, Canadian Public Health Association, Toronto, December 16-17, 1940.

W form, Vi phage typing methods alone would completely fail to demonstrate their true identity. An instance of this doubtless rare contingency is recorded in this paper, which reports the repeated isolation of only W form colonies of *S. typhi* from a severe case of typhoid fever. Also described is a hitherto unreported type of phage, isolated from the same individual, and capable of acting upon certain V forms, and their derivative W forms, of *S. typhi*.

Isolation of W Form of S. typhi from Blood and Faeces of Typhoid Fever Case

About ten days after the onset of symptoms of a severe, but otherwise clinically-typical case of typhoid fever in a young man, a micro-organism having the cultural characteristics of *S. typhi* was isolated from a blood sample. The culture, however, proved completely resistant to the I-III-IV phage mixture used at critical test dilution. The Widal reaction was positive to 1:1280 for H, and to 1:640 for O agglutinins; but there were no detectable V agglutinins in either this or subsequent blood specimens. Positive stool cultures for *S typhi* were also obtained on bismuth sulphite agar poured plates from specimens submitted 16, 18, 20, 22 and 43 days after receipt of the positive blood culture, although only one colony could be identified on the last of these occasions. Negative stool cultures were obtained 14 and 27 days after receipt of the positive blood culture. Numerous colonies picked as typical of *S. typhi* from this series of stool culture plates resembled colonies of the blood culture strain in being fully resistant to the action of the I-III-IV mixture used at critical test dilution. Moreover, several such colonies, tested against undiluted I, II, III and IV phages respectively, proved fully resistant thereto. Samples colonies tested for agglutinability against specific V and O rabbit sera gave no agglutination with the former, and agglutinated to high titre with the latter. Thus a pure W form of *S. typhi* had apparently been isolated both from the blood stream and from five stool specimens from this patient.

Isolation of Vi-W Phage from Faeces of Same Typhoid Fever Case

Craigie and Brandon (3) have pointed out that if Vi phage is present in a stool specimen to any considerable extent, it will inhibit growth of the V form, and only the resistant W form will be obtained; and that hence, if only W forms are isolated from faeces, the specimen should be examined for Vi phage. We accordingly sought a Vi phage in stool specimens from this case.

Filtrates made from two of the stool specimens received after the blood culture had proved positive, gave no evidence of containing bacteriophage. However, when colonies of *S. typhi* on the original bismuth sulphite agar plates of the stool specimens received 18 and 20 days after the positive blood culture findings, were picked into nutrient broth, incubated briefly, and the young cultures streaked on Endo's medium, bitten colonies characteristic of phage activity appeared overnight. Phage preparations were made from several of the bitten colonies. All such preparations consistently gave confluent

lysis to high titre when applied on nutrient agar plates, according to the method of Craigie and Yen (4), to areas previously inoculated with 4-hour broth cultures of sample colonies of the W forms of *S. typhi* isolated on different occasions from the patient. In view of its property of acting upon W forms, this phage was evidently not comparable to the known Vi phages. On the other hand, a few preliminary tests showed that certain types of the V form of *S. typhi* were susceptible to this phage. The new phage was therefore provisionally designated X, and its lysogenic properties were tested against cultures representative of all the recognized types, from A to M, of the V form of *S. typhi*. From the foregoing cultures, the corresponding W forms were prepared, and their susceptibility to phage X was likewise determined. The purity of each V and W culture was verified by its reactions to Vi phages, and to V and O rabbit sera. The susceptibility of the various cultures to lysis by phage X is shown in table I.

The V forms of *S. typhi*, types E_2 and F_2, and the W forms derived therefrom, proved completely resistant to an undiluted phage X preparation whose critical test dilution against the original host strain was 1 in 5×10^4. Types B_2, D_1, G, and H, in their V and derivative W forms, showed slight degrees of susceptibility to the undiluted phage X, but were completely resistant to the higher dilutions. Types A, B_1, B_4, C, D_2, D_3, E_1, F_1, J, L, M, and an imperfect V strain, again in both their V and the derivative W forms, showed confluent lysis with phage X in critical test dilutions ranging from the undiluted phage for type F_1, to a dilution of 1 in 10^4 for type B_1. In general, the V and W forms of a given type culture showed similar degrees of susceptibilty to phage X. But throughout the series the V form proved somewhat more resistant than its derivative W form; and with a few types (notably B_3 and B_4) the W forms showed a markedly higher susceptibility than the parent V forms.

Incidentally, it may be noted here that some of the more resistant types showed a slight or partial inhibition of growth, distributed uniformly over the areas inoculated with undiluted phage. Again, a ground glass appearance was occasionally apparent with both the V and W forms of certain cultures in areas where undoubted confluent lysis had occurred. One other peculiarity of this phage was the not infrequent production of a complete ring of lysis around the periphery of phage-inoculated areas whose central portions might show only a few plaques. The mechanism and significance of these phenomena are not clear.

Notwithstanding a few obscure points of minor import, such as the foregoing, the findings recorded in table I clearly warrant phage X being classed as a Vi-W phage having selective affinities of varying degrees for both V and W forms of certain types of *S. typhi*. No extensive effort has been made to determine whether its range of specificity includes micro-organisms other than *S. typhi*, but the undiluted preparation has given partial lysis with a strain of *B. coli*, and with a strain of *S. paratyphi B*; while up to a dilution of 1 in 10^3 phage X produced confluent lysis with an unidentified non-lactose-fermenting micro-organism isolated from the faeces of a patient with an illness of undetermined origin.

TABLE I

LYSOGENIC PROPERTIES OF PHAGE X AGAINST V AND W FORMS OF TYPE CULTURES OF S. TYPHI

Type and Form of Culture	Dilution of Phage X							
	undil.	$1/10^2$	$1/5x10^2$	$1/10^3$	$1/5x10^3$	$1/10^4$	$1/5x10^4$	$1/10^5$
A.....V	CL	CL	CL	CL	SCP	++s	+s	+s
.....W	CL	CL	CL	CL	SCP	++n	+++n	SCP
B_1.....V	CL	CL	CL	CL	CL	CL	SCP	SCP
.....W	CL	CL	CL	CL	CL	CL	SCP	SCP
B_2.....V	partial	−−	−−	−−	−−	−−	−−	−−
.....W	partial	−−	−−	−−	−−	−−	−−	−−
B_3.....V	partial	−−	++m	++s	+s	−−	−−	−−
.....W	CL	CL	CL	+++s	+++s	+++s	+s	+s
B_4.....V	CL	SCP	++s	++s	+s	+++n	+++n	+n & s
.....W	CL	CL	CL	CL	SCP	SCP	SCP	SCP
C V	CL	CL	CL	CL	CL	SCP	++s	+s
.....W	CL	CL	CL	CL	CL	CL	+++n	++n
D_1.....V	v. sl.	−−	−−	−−	−−	−−	−−	−−
.....W	partial	−−	−−	−−	−−	−−	−−	−−
D_2.....V	CL	CL	SCP	+++s	+++s	SCP	+++n	++n
.....W	CL	CL	CL	CL	SCP	SCP	SCP	+++n
D_3.....V	CL	SCP	SCP	SCP	SCP	SCP	++n	+n
.....W	CL	CL	SCP	SCP	SCP	+++s	SCP	+++n
E_1.....V	CL	CL	+++s	+++s	++s	++s	+s	+s
.....W	CL	CL	CL	SCP	+++s	++s	+n	+n
E_2.....V	−−	−−	−−	−−	−−	−−	−−	−−
.....W	−−	−−	−−	−−	−−	−−	−−	−−
F_1.....V	CL	−−	−−	−−	−−	−−	−−	−−
.....W	CL	−−	−−	−−	−−	−−	−−	−−
F_2.....V	−−	−−	−−	−−	−−	−−	−−	−−
.....W	−−	−−	−−	−−	−−	−−	−−	−−
G V	partial	−−	−−	−−	−−	−−	−−	−−
.....W	partial	−−	−−	−−	−−	−−	−−	−−
H V	partial	−−	−−	−−	−−	−−	−−	−−
.....W	partial	−−	−−	−−	−−	−−	−−	−−
J V	CL	SCP	SCP	SCP	++s	++s	+s	+s
.....W	CL	CL	CL	SCP	SCP	SCP	++n & s	++s
L V	CL	CL	CL	SCP	++s	+s	+s	+s
.....W	CL	CL	CL	CL	SCP	CL	+++n	+n
M.....V	CL	SCP	+++m	++m	+m	+m	+m	+s
.....W	CL	CL	+++m	+++s	++s	++s	+s	+s
Imp. V..V	CL	CL	SCP	SCP	SCP	SCP	++n & s	+s
.....W	CL	CL	CL	SCP	SCP	SCP	+++n & s	++n & s

CL = confluent lysis; SCP = semi-confluent plaques; +++, ++, & + = large numbers, moderate numbers, and a few plaques, respectively; m, s, and n = minute, small, and normal-sized plaques, respectively; — = no evidence of phage activity.

V. sl., slight, and partial, indicate varying degrees of uniform inhibition of growth over the phage-inoculated areas of the cultures.

The *critical test dilution* (the highest dilution giving confluent lysis) of phage X against its parent W form was 1 in $5x10^4$.

Clinical and Epidemiological Data

The patient was an 18-year-old white male who had been working in the restaurant attached to a hop-yard during the period in which he probably contracted his infection. The patient showed no bowel haemorrhages at any time, and recovered without complications after a two-months' illness; but in every other respect he suffered a very severe attack of typhoid fever. For several weeks he was irrational and stuporous, and subsequently recalled nothing of the events of those weeks. His physician described it as "the worst typhoid case I have seen, and my father who has been practising for 30 years states that this was the worst case he had seen recover, and that he had never seen a more severe 'mental' type."

Around the time of this patient's illness, at least six other cases of typhoid fever occurred among Indians who had been working in the same hop-yard. These cases were identified as due to *S. typhi* of types B_1, B_2 (2 cases), C, E_1, and M (2 cases) respectively. In view of these findings, and of the numerous opportunities for contracting typhoid fever as a result of associating with Indians during the hop-picking season, it was deemed futile to attempt to trace the source of this patient's infection, or to find a possible carrier of a W form of *S. typhi* among his contacts.

Comments

In an earlier report (1) we recorded the isolation of 2 V types of *S. typhi* from the faeces of a patient with typhoid fever. There was no conclusive evidence that this finding was attributable to double infection, and *in vivo* type instability provided an alternative explanation of at least equal validity. The present communication has recorded the further unorthodox observations, bearing on the Vi phage-typing methods for identifying *S. typhi*, of a case of typhoid fever apparently due to a W form, and of the concurrent presence in the faeces of a hitherto-unreported kind of Vi-W phage.

One of the main purposes in placing these observations on record has been to illustrate the fact that the public health laboratory, because of its opportunities for examining fresh specimens, direct from cases or carriers, should be especially alert to the possibility of detecting such exceptions to the general rule, rare though they may be, and should not too readily assume the infallibility of any new procedure, however well authenticated. Our findings are not held to detract seriously from the importance of the epidemiological clues, and of the more prompt means of identification, frequently afforded by the Vi phage-typing methods. Indeed, after three years' experience of them, we would strongly urge their adoption by other public health laboratories, especially where local circumstances permit close collaboration to be maintained between the laboratory and a trained epidemiologist. But it now seems clear that these phage-typing methods should supplement, and not replace, the more familiar tests for the identification of *S. typhi*.

Hitherto, the available evidence has apparently indicated that the W form of *S. typhi* was avirulent for man. Recently-isolated cultures of W form

have been ascribed by Craigie and Brandon (3) to early spontaneous degradation, or to the concurrent presence of a Vi phage. But in the case reported here, the facts point to the infection having been due, from the beginning, to a W form of *S. typhi*. The blood culture taken as early as the tenth day after systems developed, and five stool specimens subsequently sent in, yielded only W forms. Neither at the time of taking the original blood specimens, nor later, were V agglutinins detected in the patient's serum, although high H and O agglutinin titres developed. A V-W degradation occurring shortly after infection might account for this absence of any apparent V agglutinin formation; but in such event, the severity of the clinical symptoms which transpired would still have to be ascribed to the W form of *S. typhi*, whose presence throughout the illness was demonstrated. Moreover, this assumption of an *in vivo* V-W degradation would, according to current views, presuppose the presence in the faeces of a Vi phage. In the case in question, no Vi phage was found, but instead there was isolated, from two consecutive stool specimens, a Vi-W phage to which this W form of *S. typhi* was fully susceptible.

Incidentally, although the concurrent presence of a Vi phage in the faeces may well be occasionally responsible for a complete *in vivo* V-W degradation of *S. typhi*, this degradation is apparently not inevitable under such circumstances. For we have recently followed a severe case of typhoid fever in which, five weeks after the first stool culture had proved positive for *S. typhi* of type B_2, the concurrent presence in the faeces of a Vi phage was noted. Over the succeeding ten weeks, this phage was detected in 21 out of 22 successive stool specimens examined, all of which proved positive for *S. typhi*. On each of these occasions, the several colonies picked for Vi phage-susceptibility tests all yielded a preponderance of V forms of type B_2.

Some theoretical interest also attaches to the peculiar selectivity of action of phage X, and seems worthy of brief comment. Many workers have noted close relationships between the phage-susceptibility and the antigenic structure of various micro-organisms. In particular, Craigie and Brandon (5) marshalled the evidence pointing to a correlation, in the case of *S. typhi*, between the V agglutinogen and susceptibility to Vi phage I. Later (3) these authors went so far as to claim a close relationship, if not actual identity, of the "surface patterns" or "molecular configurations" on the surface of the micro-organisms which "are responsible for the specific adsorption" of V agglutinogen and of Vi phage. The validity of this contention was weakened when Craigie and Yen (4) soon afterwards described other types of Vi phage, whose activities against V forms of *S. typhi* proved more selective and circumscribed. The peculiar type of selective action of phage X seems finally to discountenance any likelihood of the V agglutinogen being always related to, still less identical with, the Vi phage-receptor. For this Vi-W phage exhibits a selectivity of action which seems related less to the presence or absence of the V agglutinogen than to those functional or structural peculiarities of organization which, in a given culture of *S. typhi*, presumably determine its type. In other words, the properties of the Vi-W phage indicate that those factors whose presence in a V form of *S. typhi* permit the culture to be typed by Vi phage II, are not

themselves either lost or inhibited when the V agglutinogen disappears from the culture in the course of V-W degradation.

SUMMARY

1. Of 94 V form cultures of *S. typhi* isolated in British Columbia, 11 (11.7 per cent) were of type M. This type is almost resistant to Craigie's Vi phage I-IV mixture, but is readily lysed by Vi phage III.

2. A W form of *S. typhi* was isolated from the blood stream on the tenth day after onset of a clinically-severe case of typhoid fever, and also from stool specimens sent 16, 18, 20, 22 and 43 days after receipt of the blood specimen. No V form colonies were found on any occasion, and the patient developed no circulating V agglutinins.

3. This W form of *S. typhi* was susceptible to a phage provisionally designated X, found to be concurrently present in certain of the stool specimens received from the patient. This phage exhibited a wide range of selective action when its lysogenic powers were tested against cultures representative of all the known types of the V form of *S. typhi*, and against their derivative W forms.

4. Phage X displayed Vi-W lytic propensities, which were apparently type-specific rather than form-specific: i.e., were exerted to a degree which depended upon the original type designation of the cultures, rather than upon whether they were in V or W form at the time of testing.

ACKNOWLEDGMENT

We wish to place on record our thanks to Dr. R. W. Patten of Chilliwack, B.C., for his kind co-operation in sending us so many specimens from his patient, and in supplying us with a complete clinical history.

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Typing of Meningococci

Preliminary Report on the Survival of Group I (Types I-III) and Type II Strains of Meningococci in the Blood of Normal Guinea-Pigs

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with the technical assistance of Colin Cameron

PREVIOUSLY (1) (2) (3), it was shown that pathogenic strains of meningococci survived in samples of blood from normal guinea-pigs when set up in a test to determine the bactericidal power of the blood. It was formerly observed that virulent strains survived in the blood of normal guinea-pigs and that similar samples of blood did not support the growth of avirulent strains of meningococci (2). Later, typing revealed that the strains employed in the foregoing tests were type II (4). In a series of experiments, as yet unpublished, it was noted that virulent strains of meningococci, group I (types I-III) and type II, behaved in a different manner when set up in the bactericidal test with the addition of normal guinea-pig blood. Recently, we have compared the survival of a number of pathogenic group I and type II strains in samples of blood from normal guinea-pigs.

Experimental

Typing of 29 blood and cerebrospinal fluid strains obtained from patients with meningococcus infections in recent years was carried out by the method outlined in a previous report (4): method (b). These strains were also examined for their ability to survive in samples of citrated blood from normal guinea-pigs according to the method described in a previous report (3). Table I records the results of these experiments.

Discussion of Results

From the results of the experiments as outlined in the table, it is to be observed that fourteen strains were group I and that eleven strains were type II when tested with group I and type II (absorbed) agglutinating sera. Four of these strains as seen by the table showed cross-agglutination in the two sera. However, the titre was higher in group I serum with one strain, higher in type II serum with two strains and indefinite with one strain. Looking at the results of the bactericidal test it is to be seen that group I strains do not survive in normal guinea-pig blood when the blood is mixed with the higher dilutions of meningococcal suspension. In most instances group I strains do not survive in any dilutions of the "blood-bacterial mixture." On the other hand, type II strains survive in normal guinea-pig blood out to a dilution of 1/10,000 and 1/100,000 of the strain under test. It would appear that the ability of pathogenic meningococci to survive in samples of

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blood from normal guinea-pigs is another means of classification which apparently differentiates group I strains from type II strains very clearly. This observation is only intended to record preliminary observations and the author is at a loss to explain this interesting differentiation of strains of

TABLE I

Strain	Type by agglutination with group I and type II absorbed sera	Growth of dilutions of meningococcal suspension in normal guinea-pig blood				
		1/10	1/100	1/1,000	1/10,000	1/100,000
No. 520*	I	±	−	−	−	−
Kirlin	I	±	−	−	−	−
Strain C.S.F.	II	+	+	+	+	+
Herrington C.S.F.	II	+	+	+	+	+
Hay C.S.F.	II	+	+	+	+	+
Bishop C.S.F.	I	−	−	−	−	−
Gilhooley C.S.F.	II	+	+	+	+	+
O'Rourke C.S.F.	I	−	−	−	−	−
Bacon C.S.F.	I	−	−	−	−	−
Humphries C.S.F.	I	+	−	−	−	−
Zanini B.C.	I	−	−	−	−	−
Smith B.C.	II	+	+	+	+	+
Large C.S.F.	II	+	+	+	+	+
McDonald C.S.F.	II	+	+	+	+	+
Dilworth B.C.	II	+	+	+	+	+
Deganis C.S.F.	I	−	−	−	−	−
Johnston C.S.F.	I	−	−	−	−	−
Keys C.S.F.	I	−	−	−	−	−
Love C.S.F.	Cross agglutination	−	−	−	−	−
Woodley C.S.F.	II	+	+	+	+	+
Butson C.S.F.	I	−	−	−	−	−
Carter C.S.F.	II	+	+	+	+	+
Young C.S.F.	Cross agglutination	+	+	+	+	+
Grogan C.S.F.	Cross agglutination	+	+	+	+	+
Ruttle C.S.F.	I	−	−	−	−	−
R. McQueen C.S.F.	I	−	−	−	−	−
Ogawa C.S.F.	I	+	−	−	−	−
Barton C.S.F.	II	+	+	+	+	+
Brocklebank B.C.	Cross agglutination	+	+	+	+	−

*—Strains obtained through the kindness of Dr. Geoffrey Rake.
B.C.—Strains obtained from blood culture of patients.
C.S.F.—Strains obtained from cerebrospinal fluid culture of patients.

meningococci. It is possible that the examination of a larger series of cultures may not reveal such a clear differentiation in guinea-pig blood with some strains. Further studies, which will attempt to explain the phenomenon, are to be carried out, including testing the separate parts of blood as well as testing samples of blood from other animal species.

SUMMARY

It has been observed that pathogenic strains of meningococci can be differentiated according to their ability to survive in samples of blood from normal guinea-pigs. Group I strains (in higher dilution) do not survive in normal guinea-pig blood and type II strains do survive. Strains showing cross agglutination in group I and type II sera are clearly differentiated as group I or type II strains by their ability to survive in the blood of normal guinea-pigs.

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The Application of the Evelyn Photo-Electric Colorimeter to a Modification of Kay and Graham's Phosphatase Test*

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THE modification described in this paper enables readings to be taken in the Evelyn photo-electric colorimeter† and reduces the cost of the reagents used in the test.

To obtain suitable colorimeter readings, it was necessary to use less milk and less phenol reagent than indicated in Kay and Graham's method. After preliminary trials, 1 ml. of a 1 in 50 dilution of milk and 1 ml. of Folin and Ciocalteu's phenol reagent were found to be satisfactory for routine tests on samples of commercially pasteurized milk. With the small amount of milk used, 0.02 ml., the first filtration may be dispensed with and this simplifies considerably the technique.

In Test A (Short test) the determination is carried out thus:

(1) Measure 10ml. buffer substrate into each test-tube (15mm. by 150mm.).
(2) Add 1ml. of the milk dilution (1ml.+49ml. distilled water) and shake.

TABLE I

AVERAGE COLORIMETER READINGS OF COMMERCIALLY PASTEURIZED MILK SAMPLES FROM DAIRY H

TEST A

Source of Sample	No. of Samples	Date of Test 1938	Colorimeter Readings				
			Reagent Control	Single Filtration		Double Filtration	
				Past. Milk	Diff.	Past. Milk	Diff.
Regular	10	12/10	84^{2}	60^{2}	24	66^{1}	18^{1}
Farm	10	to	84^{2}	58	26^{2}	65^{2}	19
Homogenized	10	3/12	84^{2}	59^{1}	25^{1}	66	18^{2}
Jersey	2		84^{2}	55	29^{2}	60^{3}	23^{3}
Combined Averages			84^{2}	58^{1}	26^{1}	64^{2}	19^{3}

TEST B

Regular	10	13/10	86^{3}	52^{3}	34	59	27^{3}
Farm	10	to	86^{3}	52^{1}	34^{2}	60	26^{3}
Homogenized	10	4/12	86^{3}	53	33^{3}	60^{3}	26
Jersey	2		86^{3}	47^{3}	39	52^{2}	34^{1}
Combined Averages			86^{3}	51^{2}	35^{1}	58	28^{3}

Readings on the Galvanometer Scale are made to the nearest quarter of a division, and the fractions are expressed by indices thus—86^{3}, 84^{2}, 66^{1} instead of 86.75, 84.5, 66.25. This notation applies to all the tables in this paper.

Presented at the ninth Christmas meeting of the Laboratory Section, Canadian Public Health Association, Toronto, December 16-17, 1940.

†*Supplied by The Rubicon Co., Philadelphia.*

(3) Place in water bath at 47°C. for 10 minutes.
(4) Cool to room temperature (approximately 3 minutes' immersion in cold water).
(5) Add 1ml. Folin and Ciocalteu's reagent (diluted 1 in 3) and shake.
(6) Remove the liquid in excess of 10ml. by a fine-pointed pipette.
(7) Add 2ml. of 14 per cent sodium carbonate solution.
(8) Place in boiling water bath for 5 minutes.
(9) Using a Whatman no. 42 paper (9cms.), filter into colorimeter tubes (20mm.×170mm.) and when cool take readings.

The test on milk samples is carried out in duplicate as also is the control on reagents in which 1 ml. of distilled water replaces 1 ml. of the milk dilution.

In Test B (Long test), step (2) consists in adding 1 ml. of the milk dilution to the buffer substrate and covering with 3 drops of chloroform and in step (3) the tube is stoppered tightly and placed in an air incubator at 37°C. for 24 hours. Experience has shown that it is not necessary to incubate the control tubes, these being set up at the time when the test-tubes are removed from the incubator. Repeated tests with incubated and non-incubated controls showed that spontaneous dissociation of the buffer substrate did not occur to any appreciable extent after 24 hours' incubation at 37°C.

Readings with the Evelyn photo-electric colorimeter are taken by inserting in turn the control tubes, each containing a volume of approximately 12 ml., in the holder with the appropriate aperture and filter allowing maximal transmission at 660 millimicrons. The galvanometer needle is adjusted to the 100 mark on the scale, the tube is withdrawn, and the reading noted. The same procedure is carried out with the duplicate tube and the average figure calculated for the reagent control. Similarly, tubes containing the

TABLE II

AVERAGE COLORIMETER READINGS OF COMMERCIALLY PASTEURIZED MILK SAMPLES FROM DAIRY P

TEST A

Source of Sample	No. of Samples	Date of Test 1938	Colorimeter Readings				
			Reagent Control	Single Filtration		Double Filtration	
				Past. Milk	Diff.	Past. Milk	Diff.
Vat No. 1	4	12/10	84	65	20	67[2]	16[2]
Vat No. 2	4	to	84	62[3]	21[1]	68[2]	15[2]
Homogenized	4	3/12	84	63	21	69	15
Jersey	3		84	52[3]	31[1]	56[1]	27[3]
Combined Averages			84	60[2]	23[2]	65[1]	18[3]

TEST B

Vat No. 1	4	13/10	84	55[1]	28[3]	61[2]	22[2]
Vat No. 2	4	to	84	52[3]	31[1]	59[1]	24[3]
Homogenized	4	4/12	84	54[2]	29[2]	59	25
Jersey	3		84	43	41	48	36
Combined Averages			84	51[2]	32[2]	57	27

fluid from the phosphatase test are inserted and the average figure noted. Since the figures for the reagent control are variable over a period of time, the differences between the reagent controls and the pasteurized milk samples are recorded.

The method may be further simplified by omitting step (6). This results in the filtrate showing a slight increase in the blue colour, i.e. the colorimeter readings are lower by 5 or 6 mm. divisions on the galvanometer scale.

With the small quantity of milk used, the amount of milk proteins precipitated is much less than that produced in the original Kay and Graham method. As a result there is little retention of fluid by the precipitate on the filter-paper so that the volumes of filtrates remain practically equal.

In Kay and Graham's method there are two filtrations, one after the addition of the diluted Folin-Ciocalteu reagent and the other at the completion of the test. A series of tests was carried out in order to compare the colorimeter readings after a *single* filtration, i.e. at step (9), and after a *double* filtration, i.e. after step (5) as in the original Kay and Graham method and also at step (9). Tables I and II show the results obtained using samples of milk from dairies H and P in the city of Kingston, Ontario. "Regular" milk of dairy H is a bulked milk supplied from twenty small farms, each with an average herd of 22 cows; "Farm" milk is milk from a model dairy farm supporting 300 to 400 head of cattle; and "Jersey" milk is obtained from two farms with about 35 head of cattle in all. Approximately 800 gallons of milk daily or 35 per cent of the city's supply comes from this dairy. In dairy P, vats nos. 1 and 2 contain bulked milk from twenty-six small farms, each with an average herd of 12 cows. This dairy supplies approximately 500 gallons of milk daily or 20 per cent of the city's supply.

It must be noted that a slight opalescence appears in the tubes after a single filtration while those after a double filtration are clear and have a

TABLE III

VARIATION WITH TIME OF COLORIMETER-READING DIFFERENCES RELATING TO COMMERCIALLY PASTEURIZED MILK SAMPLES FROM DAIRY H

TEST A

Date of Test	Source of Sample	Filtration	Colorimeter-reading difference								
			6/11	7/11	8/11	9/11	10/11	11/11	12/11	13/11	14/11
6/11/38	Regular	Single	28	27	25^{1}	23^{3}	22^{2}	20^{3}	19^{1}	18	
"	"	Double	17	16^{3}	14^{2}	13^{1}	12	10^{3}	9^{1}	8	
"	Farm	Single	26^{2}	25^{3}	24	22^{2}	21	19^{3}	18^{1}	16^{3}	
"	"	Double	18	17^{3}	15^{2}	14	13^{1}	12^{1}	10^{3}	9^{1}	
"	Homogen.	Single	24	23^{2}	21^{2}	20^{1}	19	18^{1}	16^{2}	15^{2}	
"	"	Double	16^{1}	16	14	12^{3}	11^{2}	10^{2}	8^{3}	7^{1}	

TEST B

7/11/38	Regular	Single		38^{2}	37	35^{2}	34	32^{1}	30^{2}	29	28^{1}
"	"	Double		29^{2}	27^{3}	26^{2}	25	23^{1}	21^{3}	20^{1}	19^{2}
"	Farm	Single		33	31^{1}	30	28^{3}	27^{1}	25^{3}	24^{2}	24
"	"	Double		20^{2}	19	18	17	15^{1}	14	13^{2}	12^{1}
"	Homogen.	Single		35^{3}	34	32^{2}	31	29^{1}	27^{2}	25^{3}	25^{1}
"	"	Double		22	20^{1}	19	18	16^{2}	15	13^{2}	13

lighter blue colour. As a result the colorimeter readings are always higher when a double filtration is employed than those obtained after a single filtration for the different types of milk—Regular, Farm, Homogenized, or Jersey. The average difference in the figures, for the combined average of 32 samples, tested in duplicate, of dairy H was found to be 6.50, both for test A and B. The corresponding figures for 15 samples of dairy P were 4.75 for test A and 5.5 for test B. The colorimeter-reading differences are higher in test B than in test A both after a single and after a double filtration, while the corresponding differences for Jersey milk are higher than for any of the other types of milk.

A study of the stability of the colorimeter-reading differences was carried out as shown in tables III and IV. Readings of the reagent control and milk dilution tubes were taken daily for 8 days following the date of the tests and the colorimeter-reading differences calculated. There appears to be no advantage in the double filtration so far as the stability of the colorimeter readings is concerned. The blue tints remain stable for a day following the test but begin to fade progressively thereafter.

Using the technique described it was decided to pasteurize, in the laboratory, samples of bulked raw milk obtained from several local dairies. Ten ml. volumes of each raw milk sample were pipetted into a series of test-tubes which were then tightly corked. One of the test-tubes carried a standarised thermometer, the stem of which was immersed in the milk to a depth of 3 inches. The test-tubes were placed in a thermostatically-controlled water-bath and held as nearly as possible at the pasteurizing temperature for 30 minutes, the pre-heating time being carefully noted. The thermometer readings were recorded every minute to determine the extent of the variations; these were found to lie between ±0.5°C. Subsequently, the tubes were cooled in ice-cold water to below 10°C. (50°F.) and stored in the ice-chest for about 3 hours before being subjected to the test.

TABLE IV

VARIATION WITH TIME OF COLORIMETER-READING DIFFERENCES RELATING TO COMMERCIALLY PASTEURIZED MILK SAMPLES FROM DAIRY P

TEST A

Date of Test	Source of Sample	Filtration	Colorimeter-reading difference								
			2/11	3/11	4/11	5/11	6/11	7/11	8/11	9/11	10/11
2/11/38	Vat No. 1	Single	18^{3}	17^{3}	16^{2}	15	14^{2}	12^{2}	11^{1}	11^{1}	
"	"	Double	7^{3}	6^{2}	6	4^{2}	3^{2}	3^{1}	2^{3}	2	
"	Vat No. 2	Single	17^{2}	17^{2}	16^{3}	14^{3}	13^{1}	12^{1}	10^{3}	9^{3}	
"	"	Double	9^{3}	9^{2}	8^{3}	7^{2}	6	5^{1}	4^{1}	3^{2}	
"	Homogen.	Single	18^{3}	17^{3}	16^{2}	15	13^{3}	12^{3}	11^{2}	10^{2}	
"	"	Double	8^{3}	8	7	5^{2}	4^{1}	3^{2}	2^{2}	1^{3}	
TEST B											
3/11/38	Vat No. 1	Single		37^{3}	36^{2}	35	33^{3}	32^{3}	31^{3}	30^{3}	29^{2}
"	"	Double		20^{2}	19^{1}	18	15^{3}	15	14	13	12^{1}
"	Vat No. 2	Single		29	28	27	25^{1}	25	23^{3}	22^{3}	22^{1}
"	"	Double		24^{3}	23^{1}	22	19^{2}	19	17^{1}	16	14^{2}
"	Homogen.	Single		35^{1}	33^{1}	32	30	29^{1}	28	27	26
"	"	Double		26^{1}	24	22^{3}	20^{2}	20	18	17^{3}	16

Table V shows the results of 17 experiments in which tests A and B were applied to 4 or 8 test-tube samples, taken as described above from the bulked, raw milk sample and pasteurized in the laboratory at 60.55°C. (141°F.), 61.66°C. (143°F.), and 62.77°C. (145°F.) respectively for 30 minutes. The colorimeter-reading differences of 24 samples pasteurized at 141°F. are in close approximation, the average difference being 30.75; those for the 44 samples pasteurized at 143°F. show a moderate degree of variation, the average difference being 26.5; while those for the 48 samples pasteurized at 145°F. show slight variation with an average difference of 22.25.

The corresponding figures for test B are 41, 36.5 and 30.75.

These results when plotted on a graph show a linear relationship both for test A and test B (figure 1, page 128).

If we assume that the values of the colorimeter-reading differences for

TABLE V

AVERAGE COLORIMETER READINGS OF LABORATORY PASTEURIZED MILK SAMPLES AT 141°F., 143°F., 145°F.

TEST A

Date of Test 1939	Pre-heating time in minutes	Average Past. Temp. in degrees F.	Number of Samples	Colorimeter Readings			Average Difference
				Reagent Control	Past. Milk	Difference	
22/5	8	140.99	8	86[2]	54[2]	32	
23/5	10	141.08	8	86	56[1]	29[3]	
25/5	9	140.99	8	87[1]	57	30[1]	30[3]
2/2	6	143.10	4	83[3]	61	22[3]	
14/2	15	142.97	4	83	62[1]	20[3]	
16/2	15	143.06	4	82[3]	58[2]	24[1]	
25/2	15	142.88	4	85	58[3]	26[1]	
2/3	15	143.06	4	83[3]	58[2]	25[1]	
4/3	10	142.95	8	85[1]	54	31[1]	
11/3	10	142.93	8	87	52[2]	34[2]	
16/3	10	142.93	8	86[1]	58[2]	27[3]	26[2]
19/4	10	145.22	8	82[3]	62[3]	20	
25/4	10	145.13	8	83[3]	59[3]	23[3]	
3/5	10	145.04	8	83[1]	63	20[1]	
12/5	6	145.13	8	84[3]	64[2]	20[1]	
16/5	10	145.14	8	83[3]	59[1]	24[2]	
19/5	10	145.14	8	84[1]	59[3]	24[3]	22[1]

TEST B

23/5	8	140.99	8	88	47[3]	40[1]	
24/5	10	141.08	8	90	48	42	
26/5	9	140.99	8	92	51[2]	40[2]	41
3/2	6	143.10	4	86	53[2]	32[2]	
15/2	15	142.97	4	84	52	32	
17/2	15	143.06	4	87	52[3]	34[1]	
26/2	15	142.88	4	87	51[3]	35[1]	
3/3	15	143.06	4	90	53[2]	36[2]	
5/3	10	142.95	8	90	49	41	
12/3	10	142.93	8	89	45[1]	43[3]	
17/3	10	142.93	8	91	55	36	36[2]
20/4	10	145.22	8	83[3]	57	26[3]	
26/4	10	145.13	8	89	55[3]	33[2]	
4/5	10	145.04	8	84[3]	54[1]	30[2]	
13/5	6	145.13	8	85	58	27	
17/5	10	145.14	8	89	56[2]	32[2]	
19/5	10	145.13	8	86[3]	52[3]	34	30[3]

pasteurization at 143°F. are distributed normally, the standard error (σ) is found to be $\pm$ 4.21 for test A. A variation of $\pm 2\sigma$ on either side of the computed mean value would include 95 per cent of the possible values, hence we would expect values for milk samples pasteurized at 143°F. for 30 minutes to lie within the range 18 and 35. Similarly, the standard error (σ) for test B is ± 3.74, so that 2σ is 7.5 and the range 29 to 44.

A reading *below* the minimum values of 18 (test A) and 29 (test B) indicates that the milk has been pasteurized at a higher temperature than 143°F. or held for a longer time than 30 minutes, while a reading above the maximum values of 35 (test A) and 44 (test B) means inefficient pasteurization.

Tables VI and VII show the results of tests A and B applied to 32 milk samples from dairy H and 16 samples from dairy P, all the samples being commercially pasteurized. If we adopt the criteria determined from the laboratory pasteurized samples, then only one sample from dairy H would be suspected as improperly pasteurized according to test A, but exonerated according to test B. It may be noted that in test B there are four readings below the minimum value of 29.

In samples from dairy P, one is above the maximum value of 35 in test

TABLE VI

COLORIMETER READINGS OF 32 COMMERCIALLY PASTEURIZED MILK SAMPLES FROM DAIRY H

Date of Test 1938	Source of Milk Sample	Colorimeter Readings					
		Test A			Test B		
		Reagent Control	Past. Milk	Difference	Reagent Control	Past. Milk	Difference
12/10	Regular	86	59	27	84	57^{1}	26^{3}
15/10	"	82^{2}	61^{1}	21	88	55^{3}	32^{1}
19/10	"	84^{3}	54^{2}	30^{1}	87	47	40
26/10	"	84^{3}	65^{2}	19^{1}	86	54^{2}	31^{2}
29/10	"	83^{2}	60^{1}	23^{2}	85^{1}	53	32^{1}
5/11	"	84^{3}	56^{3}	28	86^{2}	47^{3}	38^{3}
9/11	"	85	62^{3}	22^{1}	86^{2}	50^{3}	35^{3}
12/11	"	83	64^{2}	18^{2}	86^{3}	46^{1}	40^{2}
19/11	"	84^{3}	62^{1}	22^{2}	89^{3}	58^{3}	31
3/12	"	85^{3}	56^{1}	29^{2}	87^{1}	56	31^{1}
12/10	Farm	86	57^{3}	28^{1}	84	61^{3}	22^{1}
15/10	"	82^{2}	61^{3}	20^{3}	88	55^{3}	32^{1}
19/10	"	84^{3}	54^{3}	30	87	50	37
26/10	"	84^{3}	60^{3}	24	86	49	37
29/10	"	83^{2}	61	22^{3}	85^{1}	53^{2}	31^{3}
5/11	"	84^{3}	58^{1}	26^{2}	86^{2}	53^{1}	33^{1}
9/11	"	85	64^{2}	20^{3}	86^{2}	44	42^{2}
12/11	"	83	59^{2}	23^{2}	86^{3}	55^{3}	31^{1}
19/11	"	84^{3}	56^{2}	28^{1}	89^{3}	55^{2}	34^{1}
3/12	"	85^{3}	45	40	87^{1}	43^{3}	43^{2}
12/10	Homogenized	86	61^{1}	24^{3}	84	56^{3}	27^{2}
15/10	"	82^{2}	58	24^{3}	88	52	36
19/10	"	84^{3}	60^{2}	24^{1}	87	45	42
26/10	"	84^{3}	59	25^{3}	86	50^{2}	35^{2}
29/10	"	83^{2}	59	24^{3}	85^{1}	59^{2}	25^{3}
5/11	"	84^{3}	60^{3}	24	86^{2}	50^{2}	36
9/11	"	85	61^{2}	23^{2}	86^{2}	53^{2}	33
12/11	"	83	61^{1}	21^{3}	86^{3}	54^{1}	32^{2}
19/11	"	84^{3}	56^{2}	28^{1}	89^{3}	56	33^{3}
3/12	"	85^{3}	54	31^{3}	87^{1}	53	34^{1}
12/10	Jersey	86	58^{3}	27^{2}	84	50	34
19/10	"	84^{3}	53^{1}	31^{2}	87	43^{1}	43^{3}

TABLE VII

COLORIMETER READINGS OF 16 COMMERCIALLY PASTEURIZED MILK SAMPLES FROM DAIRY P

Date of Test 1938	Source of Milk Sample	Colorimeter Readings					
		Test A			Test B		
		Reagent Control	Past. Milk	Difference	Reagent Control	Past. Milk	Difference
2/11	Vat No. 1	84[1]	65[1]	19	84[1]	65[1]	19
16/11	"	82[3]	59[2]	13[1]	82[3]	42[2]	40[1]
23/11	"	81[1]	60[3]	20[2]	83[3]	56[2]	27[1]
30/11	"	87[3]	60[3]	27	85[1]	57	28[1]
2/11	Vat No. 2	84[1]	66[2]	17[2]	84[1]	66[2]	17[2]
16/11	"	82[3]	62[1]	20[2]	82[3]	39[3]	43
23/11	"	81[1]	63[3]	17[2]	83[3]	46[1]	37[2]
30/11	"	87[3]	61[1]	26[2]	85[1]	58[3]	26[2]
2/11	Homogenized	84[1]	65[1]	19	84[1]	65[1]	19
16/11	"	82[1]	63	19[3]	82[3]	48[1]	34[2]
19/11	"	84[3]	56[2]	28[1]	89[3]	56	33[3]
23/11	"	81[1]	64[3]	16[2]	83[3]	47[2]	36[1]
30/11	"	87[3]	58[2]	29[1]	85[1]	56[3]	28[2]
16/11	Jersey	82[3]	53[3]	29	82[3]	37	45[3]
23/11	"	81[1]	55[2]	25[3]	83[3]	42[2]	41[1]
30/11	"	87[3]	49	38[3]	85[1]	49	36[1]

A but within the range in test B, while there are four values below the minimum of 18 in test A and seven values below the minimum of 29 in test B. One sample is above the maximum value of 44 in test B.

SUMMARY

A simple modification of Kay and Graham's phosphatase test as applied to the Evelyn photo-electric colorimeter is described, in which 0.02 ml. of milk is used. On the basis of the results from laboratory pasteurized milk samples, it appears that 95 per cent of milk samples should fall within scale readings of 18 to 35 (test A) and 29 to 44 (test B). It is suggested that this technique can be applied to detect minor errors in the pasteurization technique of commercial dairies.

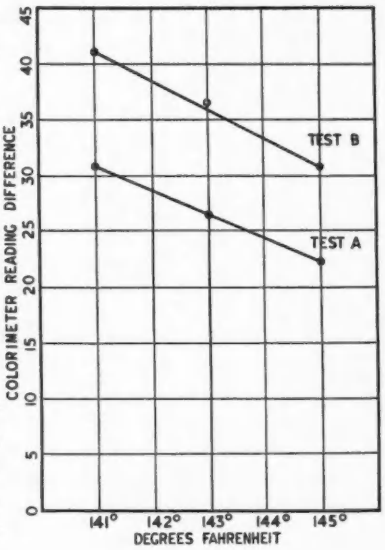

FIGURE 1

The graph for tests A and B shows a linear relationship between colorimeter readings and the temperature of pasteurization.

REFERENCE

Technical Communication No. 1, entitled "The Phosphatase Test for Control of Efficiency of Pasteurization", by H. D. Kay, R. Aschaffenburg, and F. K. Neave of the Imperial Bureau of Dairy Science, Shinfield, England, contains details of various modifications of the original Kay and Graham test.

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DIPHTHERIA IMMUNIZATION

REPORTS from Great Britain indicate the anxiety concerning the incidence of diphtheria as well as of other communicable diseases. In 1938 the number of diphtheria cases reported in England and Wales totalled 65,000, resulting in 2931 deaths. Sir Arthur MacNalty, then Chief Medical Officer of the Ministry of Health, stated that diphtheria was now the most important fatal disease at school ages.

The reports of various Canadian cities for the year 1940 are now being published. Brantford, Ontario, with a population of 30,000, maintained its position, for the eighth consecutive year, of having no diphtheria. Other cities have achieved outstanding success. Vancouver reports no case of diphtheria, in contrast with the situation ten years ago when 528 cases were reported, with 18 deaths. Toronto established a record of no cases during 1940, a record which is unique among cities of comparable size. Hamilton, Montreal, Windsor, Ottawa, Edmonton, Calgary, and Winnipeg all record the control of diphtheria through the use of diphtheria toxoid.

But the year 1940 also recorded a serious outbreak of diphtheria in the city of Halifax and its environs and a continued incidence of the disease in the city of Quebec, with isolated outbreaks in other communities throughout Canada. The menace of diphtheria is very real. The protection of a community depends upon the adoption of a policy by the health department which, through proper planning and continuous education of the public, results in preschool children as well as school children being properly protected. In many municipalities there are real difficulties to overcome but the evidence is convincing. Citizens, as well as the medical officer of health and the physicians of the community, are responsible for the tragedy of unnecessary deaths and the waste of public funds in treating a disease for which we have an effective means of prevention.

In this issue is recorded a description of the administration of diphtheria toxoid and the results of Schick testing in Glace Bay, Nova Scotia, by C. J. W. Beckwith. The article is timely and serves once more to emphasize the practicability of controlling diphtheria by active immunization. In this study the effectiveness of diphtheria toxoid given in three doses is well attested by the

results obtained with the Schick test. In a population where three-quarters of the children are initially susceptible to diphtheria as gauged by the skin test, over ninety per cent are protected one year after three doses. It is emphasized that a community cannot be considered as secure against an outbreak of diphtheria if the child population, especially those of the preschool age-group, has not been "toxoided". Many communities still centre their efforts of immunization upon the school children. This is of course the easy way to follow but it is neither wise nor reasonable. Certain facts are reemphasized by the Glace Bay studies. Departments of health can so organize their campaigns of immunization that the medical profession may assist and share in the work. No toxoid campaign can be considered complete unless its organization includes the preschool child. The use of three doses of toxoid for mass immunization is safe and effective.

It used to be said by the late Dr. James Roberts, Medical Officer of Health of Hamilton, Ontario, that every diphtheria death should demand an inquest. There is much to endorse this statement. With a safe, inexpensive and effective antigen available, such as is diphtheria toxoid, only complacency, ignorance, and conscienceless inefficiency stand in the way of the control of one of the very great hazards of childhood.

"THE ROMANCE OF MEDICINE IN CANADA"

ALTHOUGH it is seldom that reference is made in these columns to the publication of a book, the appearance of "The Romance of Medicine in Canada"* by Dr. J. J. Heagerty affords a welcome opportunity for paying a tribute to the contribution which he has made as Canada's medical historian. This title was well merited by the publication in 1928 of "Four Centuries of Medical History in Canada", in which he outlined the development of medical practice and recorded the growth of public health.

The story behind the publication of this monumental work is known to only a few. Its preparation required painstaking investigation and the examination of many hundreds of early French documents and letters in the possession of the Church and the State. Possessed with a zeal for historical research, he obtained essential information which otherwise would probably never have been made available to students of medicine. The time for these investigations had to be found outside his well-filled days as a member of the public health service of the Federal Government.

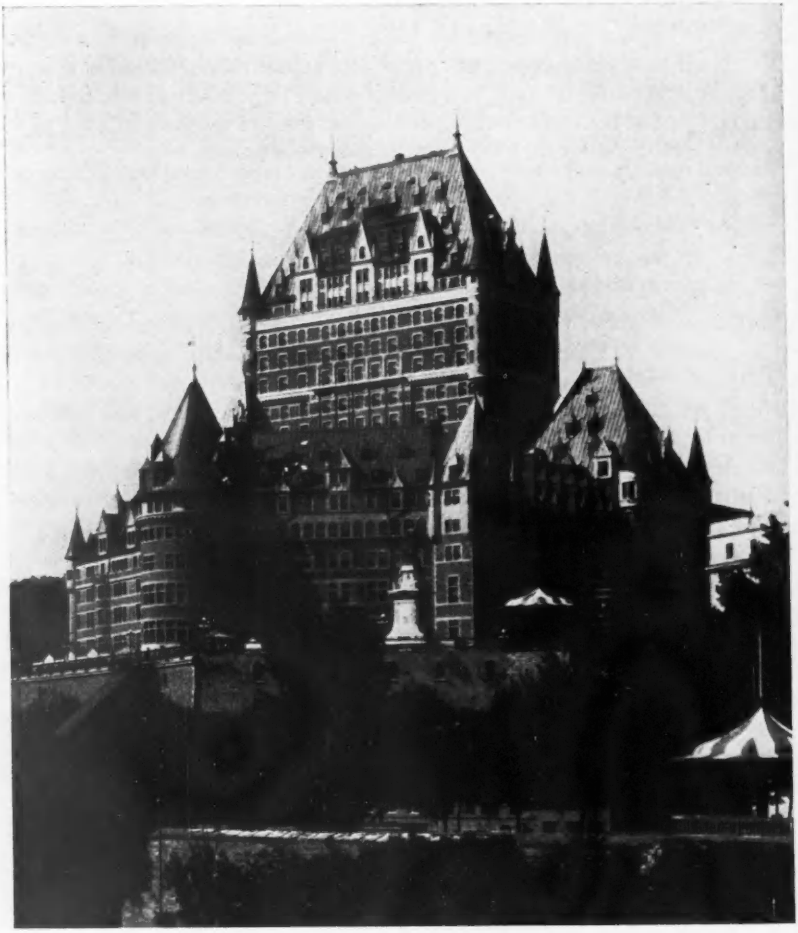
Dr. Heagerty's career has centred in public health work. He has had an intimate administrative relationship to quarantine and medical immigration problems, and his recommendations have resulted in modifications of quarantine practice which have been internationally adopted. As Director of Public Health Services in the Department of Pensions and National Health, he has continued to stimulate interest in medical history in Canada, through radio addresses and

*"*The Romance of Medicine in Canada*", by J. J. Heagerty, M.D., C.M., D.P.H. *Toronto*: *The Ryerson Press*, 1941. 113 *pages*. $1.25.

now in the popular volume entitled "The Romance of Medicine in Canada". This book is most readable and will provide an authoritative outline for students and the general public and will be appreciated also by physicians. Dr. Heagerty has arranged that the author's royalties from its sale are to be contributed to the Canadian Red Cross for the relief of victims of the war.

CHARLES VALUE CHAPIN
1856-1941

FEW men in public health work have made a greater contribution than did Dr. Charles V. Chapin, who died on January 31st. His name may not be familiar to younger members of the medical profession and public health workers, yet the fundamental conceptions concerning the sources and modes of infection which he expressed and demonstrated in his home city of Providence, Rhode Island, constitute the very basis of modern practice. It was Dr. Chapin who introduced the methods of nursing which are commonly described as aseptic nursing and who stressed the importance of concurrent disinfection. In the City Hospital at Providence are the wards where he demonstrated that cases of diphtheria and scarlet fever may be cared for in the same ward without cross-infection. His volume "Sources and Modes of Infection" will always be regarded as the presentation of sound and effective principles in the control of communicable diseases. A great debt is owed to The Commonwealth Fund for the publication in 1934 of his collected papers. For forty-seven years, from 1884 to 1931, he was Medical Officer of Health of the City of Providence, an achievement which probably is a record in tenure of office of medical officer and evidence of the uniqueness of his character. He will be remembered not only because of the effectiveness of the Health Department which he created and directed but also because he proved to the world that a health officer could so record, in permanent form, the daily work of his department that the records would provide most important statistical data from which future students of public health could formulate methods of control.



Thirtieth Annual Meeting

CANADIAN PUBLIC HEALTH ASSOCIATION

QUEBEC, JUNE 9th-11th, 1941

HEADQUARTERS: CHATEAU FRONTENAC

THE thirtieth annual meeting of the Canadian Public Health Association will be convened in the City of Quebec on June 9th, 10th, and 11th. It is interesting to recall that a quarter of a century ago, during the last war, the fifth annual meeting of the Association was held in the same city. The last war brought to light serious defects in the well-being of our population from the standpoint of their physical and mental health, and it was realized that greater attention must be paid to health. Comparison of the program for the 1916 meeting with the preliminary program for the 1941 meeting affords striking evidence of the advances that have been made in public health. The program of the 1916 meeting presented the need for the creation in Canada of a Federal department of health, for legislation for the control of venereal disease, and for the provision of an adequate immigration medical service; the inadequacies of the system of part-time medical officers of health; and the seriousness of the problem of tuberculosis, with inadequate facilities for diagnosis and treatment in all the Provinces. The program contained the names of such outstanding public health pioneers as Dr. J. D. Pagé, Dr. F. Montizambert, Dr. J. G. FitzGerald, Dr. C. J. O. Hastings, Dr. J. W. S. McCullough, Dr. Arthur Vallée, Dr. M. M. Seymour, Dr. P. H. Bryce, Dr. W. H. Hattie, and Dr. Helen McMurchy. Progress followed the defining and subsequent presentation of these needs. Before the war closed, legislation for the control of venereal diseases was enacted in Ontario and shortly after in other provinces. Public health nursing services were initiated. New fields of public health were introduced, including mental hygiene, industrial hygiene, and social hygiene; and a complete change in the form of health administration—the full-time rural health unit—was introduced as a means of providing adequate public health services in rural municipalities. The 1941 convention will record further progress in the whole broad field of public health. The urgent needs in public health today, particularly as they are emphasized by the conditions created by the war, will be considered.

The thirtieth annual meeting will afford an opportunity to gain a picture of the great progress that has been made in the Province of Quebec. Meeting in Quebec City with the members of the staff of the Ministry of Health, the extent of the forward movement in public health in Quebec will be learned and the success of the county health unit organization appreciated. Recognizing the inadequacies of health services provided by local part-time medical officers, the Province of Quebec has, in twelve years, provided full-time health services for more than seventy-five per cent of the rural population. The forty-five health units now in operation are directed by medical officers with post-graduate training in public health. The service being rendered by the Ministry of Health, with the co-operation of the municipalities, is rapidly reducing the death rate among infants and in the younger age-groups from all communicable diseases, as well as the deaths at all ages from typhoid fever and tuberculosis.

It is gratifying to compare the progress, the facilities, and the resources of the tuberculosis program of 1941 with those of 1916. There is, however, an even greater appreciation today of the loss occasioned by tuberculosis in Canada; and tuberculosis control will occupy an important place in the program. There will also be presented a series of papers on the newer knowledge of venereal diseases and methods of control, including an outline of legislation that has just been introduced in the Province of Quebec. The program of 1916 did not make reference to many other subjects which will be included in this year's program—among them, the problems of nutrition, which are in the forefront today; the health supervision of industrial workers, more important than ever in wartime; and the relation of housing to health.

PUBLIC HEALTH EDUCATION

CREATING COMMUNITY INTEREST IN THE HEALTH DEPARTMENT THROUGH THE PRESS

THE use of the columns of the local newspapers to acquaint the citizens of Hamilton, Ontario, with the activities of the health department in an annual health section was inaugurated in June 1927. The two local newspapers, in planning special editions commemorating the Jubilee of Confederation, asked the late Dr. James Roberts, then Medical Officer of Health, to supply an illustrated article describing the advance of public health in the city since Confederation. Under his direction two full pages of material outlining the work of the various divisions of the Health Department were prepared. He reviewed the progress of the Department since 1905, recording in graphic form the marked reductions in the death rate; in the infant mortality rate; and in the deaths from typhoid fever, diphtheria, and tuberculosis, stressing the value of chlorination of water, pasteurization of milk, and immunization against diphtheria. Numerous illustrations were used.

The publication of this material proved so successful, as judged by the number of enquiries from outside sources, that it was decided to publish similar articles in the special Christmas editions issued by both city newspapers. To enable the Department to have more space in the Christmas editions, the Local Board of Health approved of purchasing an additional page at reduced advertising rates. This arrangement was continued until the depression years, when the City took over the advertising for all city departments and the newspapers inaugurated a greatly enlarged health section.

The articles are submitted well in advance of the publication date by the directors of the divisions. Proofs are corrected as soon as the articles are set in linotype and the pages are made up

Health Section

The Hamilton Spectator

Health Section

VOL. XCIV. HAMILTON CANADA SATURDAY DECEMBER 14 1929 NUMBER 292

A Nation's Health Is a Nation's Wealth

CEASELESS BATTLE IS WAGED TO WIN MASTERY OF DISEASES

Field of Public Activity Embraced by Work of Board Brings Civic and Voluntary Organizations Into Program

TOLERANCE AND CONSIDERATION WILL SOLVE MAJOR PROBLEMS

Good Will, Neighbourly Attitude Can Provide Key to Conditions That Are Arising Out of National Emergency

Health Section
The Hamilton Spectator
Health Section
A Nation's Health Is a Nation's Wealth
CEASELESS BATTLE IS WAGED TO WIN MASTERY OF DISEASES
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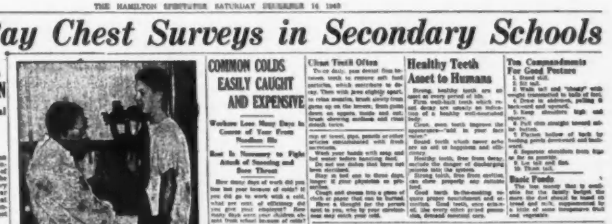
well in advance of the date of issue. The newspaper staff assists in arranging the material so that the best possible use may be made of the space available. The papers also do the photography and furnish the mats for illustrations without charge. The advertisements appearing in the section are secured by the newspaper and are carefully chosen with regard to the health news with which they are to appear.

The Department of Health feels that this annual presentation of its activities, in an attractive, easily read style, is of great value. It stimulates the staff in their daily duties and it brings to the notice of the citizens what has been accomplished on their behalf and what the effort has cost them in dollars and cents. Moreover, it tells the public of the newer trends in public health work and builds good-will and co-operation.—*J. Edgar Davey, M.B., Medical Officer of Health.*



THE HAMILTON SPECTATOR SATURDAY DECEMBER 14, 1940

Acclaim X-Ray Chest Surveys in Secondary Schools

GOVERNMENT PLACES APPROVAL ON TUBERCULOSIS PREVENTION

National Defence Is Linked With Physical Fitness of Every Enlisted Man—Tests Needed in Industry

By J. G. Bathrick, M.D., Director, Anti-Tuberculosis Clinics

When it decided to give every member of the Canadian armed forces an X-ray examination of the chest, the Dominion government set its seal of approval on modern methods of tuberculosis prevention for the national defence scheme. The preservation of the health of the men in Canada's army, navy and air force is obviously of vital importance to our war effort. No greater contribution to the preservation of that health could be made than by preventing the ravages of consumption. The industrial worker, equally important, has not received the same consideration.

Experience in Infirmary

The experience gained through [illegible] of the fatigue in the army, who would suffer from [illegible] tuberculosis, or pass the former on

COMMON COLDS EASILY CAUGHT AND EXPENSIVE

Workers Lose Many Days in Course of Year From Needless Ills

Rest Is Necessary to Fight Attack of Sneezing and Sore Throat

How many days of work did you lose last year because of colds? If you did go to work with a cold, what was your efficiency did you give your employer? How many think next year your children absent from school because of colds? A cold lowers the vitality and resistance of the person suffering from it, and it is also contagious

Clean Teeth Often

To do duty, your dental floss to remove soft food particles, which contribute to decay. Then with your mid-day snack, to rinse mouths, brush away from gums on the lower, from gums down on upper, inside and out, and chew apples and raw [illegible] teeth clean.

[illegible] sip or toast, plain, pastelle or other articles contaminated with fresh [illegible] saliva.

Wash your hands with soap and hot water before handling food.

Do not use dishes that have not been sterilized.

Visit the dentist at three days, longer if your physician so advises.

Cough and sneeze into a piece of cloth or paper that can be burned. Do not use a handkerchief that you will use again.

Do not sneeze or cough in the face of another person.

Keep your room well ventilated.

Healthy Teeth Asset to Humans

Strong, healthy teeth are an asset at every period of life.

Firm well-built teeth which remain clean are usually an indication of a healthy well-nourished body.

Clean, even teeth improve the appearance—add to your facial charm.

Sound teeth which never ache are a gift to happiness and efficiency.

Healthy teeth, free from decay, exclude the danger of disease-producing germs into the system.

Teeth which are kept in good condition, clean properly and carefully, last.

Good teeth do-the-mouthing to more proper nourishment and assimilation of food, thereby adding to the body every atom of good tissue it can demand material care.

Ten Commandments For Good Posture

1. Sit up straight.
2. Sit out.
3. Walk tall and "straight" with weight transferred to balls of feet.
4. Dress in underwear, pulling it down between shoulders.
5. Wear correct shoulder, high and waistline.
6. Wear shoes straight toward and between.
7. Keep the hollow of back by holding pelvis horizontal and backward.
8. Exercise muscles from thighs as far as possible.
9. Sit tall and [illegible].
10. Think tall.

Basic Foods

The law states that it would also for the family budget for there the diet should be based on the following basic foods: 1 pint of milk, 1 teaspoon fruit and vegetable.

THE HAMILTON SPECTATOR SATURDAY DECEMBER 14 1940

Care Exercised By Authorities to Prevent Illness

STRANGE DISEASES MAY RESULT FROM EATING UNCOOKED FOODS

Producers, Distributors and Consumers Are Urged to Co-operate In Safeguarding Citizens From Many Dangers

By W. J. Stadnuk, B.A., M.D., Director of Laboratories

Among the many activities of departments of health, in ensuring to the citizens pure food and drink, the supervision of the meat supply is by no means the least important. Eggs, oysters, fish, poultry, meat and game form a large and indispensable part of an adequate diet, chiefly because they are high in protein, one of the principal energy producing constituents.

Care Is Directed

The care exercised in the grading and inspection of eggs, to [illegible] to oil, or, indeed, are governed [illegible] of meat at the [illegible] of nationals of typhoid, traced by carriers, in England and the United States, the latest one occurring in New York city in 1936. This c.n, of course, occur only when system

Milk Is Only Food Defying Synthesis

Nature Made It For Purpose of Nourishing Human Elements Blended

Milk is the only food nature ever made solely for food. It cannot be improved artificially. Only nature herself can so perfectly blend all the elements of a well-balanced diet as she has in milk.

Man has tried for ages before of a different shape and size, it were given a material name and attempted for what it really is, as "the greatest body builder and strength producer known." Many people would flock to the "A" in their prime. But because it cannot be [illegible] and it discovered every morning at your doorstep, it is not then that its virtues are given a thought. People are apt to [illegible]

Get Genuine . . .
JERSEY MILK
For Your Health's Sake!
MORE CALCIUM
MORE RIBOFLAVIN
MORE VITAMIN
ALL BODY BUILDERS
Thus the morning your well to one of Prosperity and Happiness, is our sincerest wish to you.
AVONDALE DAIRY
114 AVONDALE AVENUE
SERVING THE PUBLIC FOR 25 YEARS
Phone 64261 — Longford Bros., Proprietors

THE HAMILTON SPECTATOR SATURDAY DECEMBER 14 1940

Immunization Is Effective Remedy Against Disease

ONCE A PERPLEXING PROBLEM, DIPHTHERIA IS NOW CONTROLLED

Educational Work Has Done Considerable Toward Reduction of Toll Taken By Communicable Ailments

Until the work of Dr. W. H. Park and his associates in the schools of New York city became generally accepted, the control of diphtheria was one of the most perplexing problems facing the health officer. For some years, the case incidence had shown a steady increase, although the case fatality rate, due to the almost universal use of antitoxin, was diminishing.

Impressive Decrease

From 1916 to 1918 there were 60 cases, with 9 deaths, in Hamilton. From 1919 to 1933 the cases reported increased 1,611, with 132 deaths.

Late in 1933, the late Dr. James Roberts, medical officer of health, heard Dr. Park's report of the demonstrating work in the schools of New York city and was so impressed with the results that he determined that the children of Hamilton should be protected by immunization of Schick positive.

In February, 1934, an immunization clinic was established in the health centre, where [illegible] were available. The Board of Education gave its consent for the work to be public schools and Dr. Roberts, the then school medical officer, gave his able and sym-

[illegible] cases and one death since to the next year, 1937.

More than ever the public became convinced of the efficacy of immunization and the [illegible] achieved up to the time spurred on the efforts of the staff of the health department to intensify the work and banish diphtheria from the city altogether.

The last deaths from diphtheria in Hamilton occurred in August, 1937, just a week two in number of 12 cases.

In the next three years a total of 4,012 new shots were accepted, the last case occurring in September, 1940.

Hamilton has not had a case of diphtheria since that time, a fact of which the department is justifiably proud and hopes. The most simplistic hopes but here two and the faith of the citizens.

PERFORMING VITAL SERVICE—Physicians and nurses of the department of health are shown in the above picture preparing to administer scarlet fever immunization to school children. This service is on a voluntary basis, and is one of the measures adopted to maintain Hamilton's record for comparative freedom from communicable diseases.

Summon Physician For Scarlet Fever

Do's and Don'ts Suggested In Event of Children Being Subject to Attack

When Pandora lifted the lid of that mysterious box in the fairy tale she tried to close all the evils of sickness and disease back into it again. She could not undo what she had done, but there was one thing that little Pandora never thought about using—that was to tell the people how to avoid catching the diseases and what to do if they never became ill with any one.

So it is left for the modern Pandora, the public health nurse, to do just that. Just as about all the diseases to mankind, to children, there are many do's and don'ts about the prevention of scarlet fever.

Scarlet fever is a disease that is easy to observe in the case of a single [illegible] patient. There are the [illegible] rash in a coarse to himself. Or to allow him to communicate with [illegible] children. Then there are the [illegible] fever discharges from the mouth, throat, eyes of other parts of the body. The parents, nursing the patient should not mingle with [illegible] children. Then there will [illegible] a light fever, during the present an individual rather used only to him. Avoid the dishes each time before using again. Give him his own spoon, cloth, fork and glassware.

Eat Fruits, Vegetables

Include two servings of each, daily, at least one preferably raw. Fruits and vegetables furnish vitamins C, which is necessary for good tooth formation. Raw fruits and vegetables are also valuable because they require chewing and provide desirable exercise for the gums.

A normal and physical growth depends much upon correct diet. Diet and correct appetite, for not decisive, but [illegible] to the [illegible]

Use Milk Every Day

Allow at least 1½ pints for a child and a pint for an adult. Milk is the best source of calcium and is an excellent source of phosphorus. The hardness of the teeth is due to the calcium and phosphorus which they contain. Strong, firm teeth cannot be built without adequate amounts of calcium and phosphorus. Butter supplying vitamin A is also important. Milk and cream are excellent sources of vitamin A, [illegible] eggs, butter are needed for [illegible] health.

For Better Health
Insist On
Prospect Dairy Milk
Safely delivers the whole family to drink milk —and tells every business to make holiday time time delicious—with milk.
Best Wishes For a Very Merry Christmas and a Prosperous, Healthy, New Year
PROSPECT DAIRY
"Milk From Selected Farms"
PHONE 7-7575 FOR QUICK SERVICE
P. Anton Jones — Burns Bros.

PUBLIC HEALTH ADMINISTRATION

The Annual Meeting of the Ontario Health Officers Association

THE annual conference of the Ontario Health Officers Association will be held in the Royal York Hotel, Toronto, on May 22nd and 23rd, under the presidency of Dr. F. A. Ladouceur, Medical Officer of Health of Casselman. Dr. H. B. Kenner of Stratford is first vice-president, Dr. J. C. Gillie of Fort William second vice-president, and Miss Mary Power of Toronto secretary. The members of the executive include Dr. C. A. Harris, London, Dr. J. E. Davey, Hamilton, Dr. J. W. Mackie, Lansdowne, Dr. G. B. Stalker, Hanover, Dr. W. E. Brown, Orillia, Dr. H. M. Young, Iroquois Falls, Dr. G. S. Cronk, Belleville, Dr. D. G. Dingwall, Dryden, and Dr. C. H. Bird, Gananoque.

A New Journal on Medical Care

THE first issue of *Medical Care*, a new quarterly, was published in January. The journal is a non-profit enterprise under the auspices of the Committee on Research in Medical Economics, Inc., 1790 Broadway, New York, with Michael M. Davis, chairman of the committee, as its editor. Williams and Wilkins Company are the publishing agents. Its stated purposes are "to disseminate information concerning the economic and social aspects of medicine, to promote a scientific approach to the subject, and to stimulate practical action by the professions and the public in their common interest. The views and interests of the professions that furnish medical care and of the people who receive it are equally to be considered."

Among the articles in the first number are: "British Medical Arrangements for the Care of Air-Raid Victims," by Dr. George F. McCleary, formerly of the British Ministry of Health; "Preparedness through Fitness," by Dr. Nathan B. Van Etten, President of the American Medical Association; "A Health Program for California Farmers," by Von T. Ellsworth, Director of the California Farm Bureau Federation; "The Costs of Physicians' Services under a Voluntary Health Insurance Plan," by Helen Hershfield Avnet of the Group Health Cooperative, New York.

Future issues will include a forum, open to signed expression of opinion by laymen and physicians; current news of legislation and private action in the field; and reviews of books, articles, and pamphlets concerning the economic and social aspects of medicine. The journal has a group of forty-five advisors including members of the medical and allied professions, social scientists, public administrators, and men and women representing the general public interest; and an editorial board composed of Ernst P. Boas, M.D., New York; Samuel Bradbury, M.D., Philadelphia; Claude W. Munger, M.D., New York; John P. Peters, M.D., New Haven; Herbert E. Phillips, D.D.S., Chicago; Kingsley Roberts, M.D., New York; George Soule, New York; and C.-E. A. Winslow, New Haven.

Refresher Course in Mental Hygiene

THE School of Nursing, University of Toronto, is offering a refresher course in mental hygiene, with special emphasis upon the subject in a wartime situation. The dates are May 14th to 17th. The course will consist of lectures, observation visits, clinical teaching, and round-table discussion of the hospital field and the public health field. The lecturers include Dr. C. M. Hincks, Director of the Canadian National Committee for Mental Hygiene; Dr. J. D. M. Griffin, Associate Medical Director of the Committee;

Dr. W. E. Blatz, Professor of Psychology, University of Toronto; Dr. C. B. Farrar, Professor of Psychiatry, University of Toronto; and Dr. C. R. Myers, Assistant Professor of Psychology, University of Toronto.

Registered nurses interested in mental hygiene may enrol for the course. The fee is five dollars.

ANNUAL CONFERENCE OF THE STAFFS OF THE ALBERTA HEALTH UNITS

THE third annual Christmas-week conference of medical officers of health and public health nurses of the Alberta full-time health units was held in the Parliament Buildings, Edmonton, on December 27, 1940, with Dr. M. R. Bow, Deputy Minister of Health, presiding. Those present included Dr. M. G. McCallum, Miss J. Campbell, and Miss N. Methuen from the Stettler unit; Dr. M. B. Donaldson, Miss L. McCulla, Miss E. J. Savich, and Miss M. Policha from the Lamont unit; Miss M. Freeman from the Red Deer unit; Dr. A. Somerville, Miss M. Scarr, and Miss S. Ross from the Foothills unit. The Sturgeon unit was represented by Dr. R. Younge and Miss C. E. Sage, and Dr. J. C. MacPherson and Miss M. Dunn attended from the Rosebud unit. Also in attendance were Dr. W. H. Hill, Medical Officer of Health of Calgary; Dr. G. M. Little, Medical Officer of Health of Edmonton; and Dr. A. C. McGugan, Mr. D. B. Menzies, and Miss K. S. Brighty of the Provincial Department of Health.

Among the subjects discussed were the preparation of a manual of standard methods for health districts, maintenance allowance for sanitary inspectors, mental hygiene in the schools, health unit records and reports, health education with particular reference to moving-picture films, and the dental hygiene program in health units. Combined injections of diphtheria toxoid and whooping-cough vaccine in infants, the use of the reinforcing dose of diphtheria toxoid, and tuberculin testing, were also discussed. Other items on the agenda included the tuberculosis program and the Rural Health Conservation Contest.

COURSE FOR DIPLOMA IN VETERINARY PUBLIC HEALTH

THE Department of Public Health and Preventive Medicine, McGill University, is conducting this year a course for veterinary graduates leading to a Diploma in Veterinary Public Health. The purpose of the course is to provide graduate training for veterinarians who plan to engage in public health work. Registration this year was limited to five, but the many applications received gave evidence of the interest in such a course and the need for it.

HEALTH SERVICES IN THE UNIVERSITY OF BRITISH COLUMBIA

ANOTHER year of steady growth is recorded in the thirteenth annual report of the University of British Columbia Health Services, which are under the supervision of the Metropolitan Health Committee of Vancouver. J. S. Kitching, B.A., M.D., D.P.H., is director of the services. More students were examined during the session 1939-40 (1,001) than ever before, the largest number in previous years being 854 in 1937-38. The quality of the service has kept pace.

Each student is examined on entrance. This examination is but the first step in the health program. If defects are found, advice is given for their correction. If the defects are not remediable, the student is given advice and encouraged to carry on to the best of his ability. Much emphasis is placed on health education in this program.

The university health services cooperate closely with the Department of Physical Education and supply them with a physical rating of each student and keep them advised of any change. On initial examination, 17.2 per cent of students had a reduced capacity for exercise.

In co-operation with the Division of

Tuberculosis Control of the Provincial Board of Health, all new students in 1939-40 were given tuberculin tests and the positive reactors were X-rayed. Fifty-one per cent showed a positive tuberculin test as contrasted with 43 per cent in the previous year but there was no actual increase in the number of cases (5 in 1938-1939 and 4 in 1939-40). The proportion of urban reactors was higher than rural.

Among the students examined, 44.5 per cent showed defects which require follow-up for correction or further investigation. Faulty vision was the most common defect found. This year particular attention was paid to the skin of the extremities. Epidermophytosis (athlete's foot) was found in 4.7 per cent of all students and prophylactic instruction was given.

An interesting table is presented to show the number of students potentially susceptible to certain communicable diseases, on the basis of not having had the disease or not having been immunized. Seventeen point six per cent of all students are thus potentially susceptible to smallpox and 84.5 per cent to diphtheria. A student on entering the University of British Columbia is required to show satisfactory evidence of vaccination, to be vaccinated, or to file an affidavit as a conscientious objector. The proportion of students from the Vancouver area who had been vaccinated was about 2 to 1 as compared with those from rural areas. There was an increase of 75 per cent in the number of immunization procedures as compared with the previous year.

The Health Service has co-operated with various agencies in campus sanitation. Part-time services were given to the Training School for Rural Leadership in the Department of University Extension, both as to physical examinations and health teaching. Various members of the University Health Service acted as lecturers to many different groups in the university during the academic year.

This year a physician trained in psychiatry was added as a part-time member of the staff of the Health Service. Thirty-nine (3.9 per cent) of students examined presented evidence of functional nervous disorder at the time of the initial examination. Emphasis will be placed on those students who show minor personality changes rather than upon those for whom immediate psychiatric treatment is needed. This is in line with the objective of the health service which is primarily prevention. Dr. Kitching feels that many more students have problems in mental hygiene than have been discovered by present methods. Next year an improved questionnaire for freshmen will be used to attempt to find a greater number of the poorly adjusted students. It is felt that the co-operation of the faculty will be needed in this effort.

This report is evidence of a well-run university health service which realizes its own shortcomings and is endeavouring to overcome them by a well-planned program of expansion.

APPOINTMENTS

DR. Maxwell Bowman has been appointed epidemiologist in the Department of Health and Public Welfare of Manitoba, succeeding Dr. Morley Elliott, who is serving in the armed forces of Canada.

DR. Hugh Malcolmson has been appointed temporarily as a member of the Department of Health and Public Welfare of Manitoba to assist Dr. C. R. Donovan in connection with hospitalization.

CURRENT HEALTH LITERATURE

These abstracts are intended to direct attention to articles that have appeared in other journals during the past month. Any of the journals referred to may be borrowed for three days or longer if desired. Address requests to the secretary of the Editorial Board.

A Comprehensive Study of Influenza in a Rural Community

ANTIBODY levels against influenza A virus were determined for 1101 persons in a rural community during a non-epidemic period. Adolescents possessed the highest mean neutralization titres while in old age the titres were much lower. The antibody levels remained very constant for a period of one year and in many persons for two years. The higher titres, however, showed a tendency to fall off. Complement fixation tests were also done on many of these sera and a small correlation was demonstrated between neutralizing and complement-fixing antibody titres.

In a subsequent epidemic of influenza A, fifty-nine of the persons studied became ill. A comparison of the preëpidemic titres of this group to the preëpidemic titres of the general population showed that susceptibility to influenza A was correlated with possession of a low titre of neutralizing antibodies but that possession of a high titre was not an absolute guarantee of immunity. The complement fixing antibody titres were not so good an index of susceptibility. Subclinical infections occurred in sixty-three persons as indicated by significant increases in neutralizing antibodies. The severity of symptoms following infection with influenza A virus was not determined by antibody levels alone, since the titres of those who became ill and those with subclinical infections were practically identical in the preëpidemic survey. This relationship persisted during convalescence and up to one year after infection so that antibody response was not related to severity of symptoms. A considerable increase in humoral immunity as measured by the neutralization test was evident at the end of one year in the sera of those who had been ill or had suffered subclinical infection.

E. R. Rickard, Edwin H. Lennette and Frank L. Horsfall, Jr., Pub. Health Rep., 1940, 55: 2146.

Possibilities for the Control of Syphilis with the Intravenous Drip Technic of Massive Arsenotherapy

THAT syphilis has not been adequately controlled by the usual routine of arsenotherapy is well recognized. Discontinuation of treatment by patients while still infective and freedom of patients while taking treatment during the infectious stage of the disease have contributed appreciably to this failure. These difficulties are overcome by the continuous intravenous drip technique of massive arsenotherapy described in this paper. The results obtained in treatment of 386 patients in the primary or early secondary stages of syphilis by this method are presented and analyzed. Part of the investigation was carried out under the supervision of a committee of experienced syphilologists and internists. Satisfactory therapeutic results were obtained in about 90 per cent of cases treated with neoarsphenamine, the Wassermann reaction remaining negative over a considerable follow-up period. This drug, however, produced some toxic manifestations and arsenoxide (mapharsen) was therefore substituted. In experimental trials, results approaching those with neoarsphenamine were obtained and toxicity was insignificant. With both drugs treatment was most successful when commenced within eight weeks after the appearance of the primary sore.

This treatment method is now on trial at many centres throughout the country and a committee has been appointed by Surgeon General Parran

to appraise the results obtained. This committee is to report to the American Medical Association in June, 1941. Should the method be approved and come into general use, the prompt control of syphilis will have been greatly facilitated. It should be particularly useful in the military and naval services where cases come under observation early.

George Baehr, Am. J. Pub. Health, 1941, *31*: 176.

The National Health Survey

THIS survey involved a house-to-house canvass of approximately 740,000 families for the collection of data regarding serious disabling illnesses, the medical services received in connection with such illnesses, and the relation of these items to certain social and economic conditions. The general findings with respect to the occurrence of disease, impairments and accidents have been recorded previously. In his present report the receipt of medical services is summarized and the following paragraph presents the basic conclusions.

"Broadly speaking, the survey shows that a large proportion of the urban population had incomes that left no margin or only a small margin for meeting the costs of medical care; that the illness rates were highest in the groups least able to meet such costs; that, in general, persons at the lowest economic levels received the least medical care; that such persons residing in smaller cities were at a particular disadvantage compared with those in larger cities, especially with respect to hospitalization."

Rollo H. Britten, Pub. Health Rep., 1940, *55*: 2199.

INDUSTRIAL HYGIENE ABSTRACTS

The Control of Tuberculosis. II. Pulmonary Tuberculosis in Employees

IN an earlier article dealing with the control of tuberculosis among employees of the Metropolitan Life Insurance Company, New York City, attention was drawn to the necessity of fluoroscopy and/or roentgenography in the examination of applicants for employment in order to detect unrecognized pulmonary tuberculosis in apparently healthy adults. However, primary infection and reinfection may occur at any age. Statistics of the ten-year period 1930-1939 inclusive, show 330 cases of clinically significant pulmonary tuberculosis in an employee-year population of 136,710 and of these 69 had had a previously negative roentgenogram. Such figures demonstrate the necessity of the second step in control, i.e. constant and vigilant supervision of the employee group in order to detect the new cases of tuberculosis in their incipiency. In this paper the author describes the case-finding program as practised among Metropolitan employees and its results.

The control program consists of (1) annual examination, including fluoroscopy in all cases, and radiography when indicated, of all employees; (2) frequent observation of contacts and of employees who have had pleurisy or other form of extrapulmonary tuberculosis and (3) radiographic examination of those who have been absent due to respiratory illness and of those with respiratory or suspicious symptoms. Only repeated frequent fluoroscopy or roentgenographic examination will detect pulmonary tuberculosis as it develops and will thereby keep it under reasonable control.

In order to learn the reasons for radiography, the 330 cases detected during the ten-year period were analysed. The two main reasons were found to be the presence of symptoms and, in asymptomatic employees, the fluoroscopic findings at periodic examination.

The average incidence rate for the

ten-year period 1930-39 inclusive, was 2.12 per 1000 males per year and 2.58 per 1000 females per year. The rate for females was greatest in the age group 20-24. Above 40, the rate for males is greater than for females.

The incidence of new cases dropped from 0.4 per cent for 1930 to 0.1 per cent for 1939. Statistics also showed that during the period when the control program was effective, the cases were diagnosed at an earlier stage, 68.2 per cent being in the minimal stage compared with 30 per cent previous to this program.

In conclusion the author maintains that the incidence of pulmonary tuberculosis can be considerably decreased and the disease can be detected at an earlier stage by frequent use of fluoroscopy or roentgenography at (1) the pre-employment examination of applicants and (2) in the medical supervision of employees.

Ada Chree Reid. J. Indust. Hyg. & Toxicol., 1940, 22:408.

Developments in Aviation Medicine

STARTLING statistics at the end of first year of the first World War revealed that of every 100 pilots killed during that period, 2 died as a result of enemy action, 8 from defective equipment, and 90 from defects in the pilots themselves. In some instances 50 per cent of the students developed neuroses while in training. During the remainder of the war medical research in aviation medicine developed rapidly and today aviation medicine is prominent as a specialty in military medicine. More recently, as civil aviation has expanded, this specialty is no longer confined to the military services. Most of the major airlines today have their own medical department.

In this article the author stresses the urgent need at the present time for the general medical profession of the country to have a thorough understanding of the physical and mental requirements for aviation, as it is they who are responsible for all clinical matters concerning those who fly. Today a large percentage of the population are flying or desire to fly. In addition, as a consideration of national defence the general medical profession must be familiar with the fundamental principles of aviation medicine. The initiation of pilot selection and training must await the organization and training of properly qualified medical personnel.

As yet the medical schools of this continent, unlike most of the medical schools in Europe, have made no organized attempt to meet this need. However a beginning has been made. The George Washington University School of Medicine, in April of last year, presented a postgraduate course in aviation ophthalmology and aviation medicine. The author expresses the belief that other courses, undergraduate and postgraduate, will eventually be provided in the medical schools throughout the country.

Harry G. Armstrong, Ann. Int. Med., 1940, *13*: 2212.

Standards for Employment of Women in Defence Program

THE present expansion of defence industries will necessitate a sharp increase of woman workers in these industries, and also the employment of women in skilled crafts, which in peace time are practically closed to women. In order that women may be successfully utilized, the United States Women's Bureau, in co-operation with the Labor Advisory Committee on Standards for the Employment of Women in the Defence Program, has prepared a report on general standards for such employment. The report deals with various factors which are briefly discussed in this article, under the following headings: (1) Jobs suited to women's physiques, (2) safety and protection against industrial poisons, (3) plant health and sanitation measures (lighting, seats, sanitation, safety, practical work clothing), (4) standards as to hours and wages, (5) employment and training policies, and (6) industrial home work.

Monthly Labor Review, September, 1940, 564.

Vitamin C in Chronic Lead Poisoning: An Experimental Study

THE role of vitamins in heavy metal poisoning, especially with reference to the nervous system, has been suggested. There are references in literature to effective treatment of chronic lead poisoning with vitamin C. It has been claimed that painters who normally have a high vitamin C intake do not develop lead poisoning. In this article the authors describe experiments which were conducted to test the efficiency of vitamin C as a therapeutic procedure in cases of chronic lead poisoning.

One group of guinea-pigs were kept on a subclinical scurvy intake of vitamin C, 0.5 mg. per day; another group were kept on a saturation level, 10 mg. per day. After a month on this routine lead carbonate was added to the diet.

The results show that though the animals on low vitamin C diet suffered greater loss of weight than the others after the lead was administered, it could not be said that the vitamin was significantly protective against weight-loss. As measured by erythrocyte counts, hemoglobin estimation and number of stippled cells, the degree of plumbism did not differ much in the two groups. As a means of preventing the onset of neuro-plumbism, the effects of high vitamin C intake were strikingly beneficial.

The analytic data presented do not show any clear-cut effect of vitamin C on lead storage but suggest that deposition in the liver tends to be greater when the animal is on the saturation diet.

Holmes and his co-workers had presented the theory that the vitamin C (the ascorbic acid) acts as a detoxifying agent by forming poorly ionized, but soluble, lead compounds. However, the experiments described in this article refute this theory and indicate that the formation of a lead ascorbate complex does not occur.

After the lead administration had been stopped, eight of the animals originally on the low vitamin C diet were raised to the 10 mg. level; seven others were retained as controls. In a month the degree of recovery in the high vitamin group was not strikingly greater than in the controls.

In conclusion, the authors maintain that, as a therapeutic measure, vitamin C is inefficient as compared to removal of exposure to lead.

L. Pillemer, J. Seifter, A. O. Kuehn, and E. E. Ecker, Am. J. Med. Sci., September, 1940, 322.